EVALUATION OF PERSONNEL PARAMETERS

IN SOFTWARE COST ESTIMATING MODELS

THESIS

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Abstract

Software capabilities have steadily increased over the last half century. The Department of Defense has seized this increased capability and used it to advance the warfighter's weapon systems. However, this dependence on software capabilities has come with enormous cost. The risks of software development must be understood to develop an accurate cost estimate.

Department of Defense cost estimators traditionally depend on parametric models to develop an estimate for a software development project. Many commercial parametric software cost estimating models exist such as COCOMO II, SEER-SEM, SLIM, and PRICE S. COCOMO II is the only model that has open architecture. The open architecture allows the estimator to fully understand the impact each parameter has on the effort estimate in contrast with the closed architecture models that mask the quantitative value with a qualitative input to characterize the impact of the parameter.

Research was performed to determine the quantitative impact of personnel parameters on the effort estimate in the closed architecture models. Using a design of experiments structure, personnel parameters were varied through three levels for each model. The data was then analyzed to determine the impact of each parameter at each level by evaluating the change from a baseline estimate. The parameters were evaluated to determine characteristics including linearity, independence between input parameters, impact range and effort multipliers. The results will enable DoD cost estimators to understand potential estimation errors resulting from inaccurately assessing each input factor. Risk ranges can be built around the final estimate based on the research results.

EVALUATION OF PERSONNEL PARAMETERS

IN SOFTWARE COST ESTIMATING MODELS

I. Introduction

General Issue

"Software spending in the Department of Defense (DoD) and NASA is significant, and it continues to increase" [1, 6-1]. The United States government and business sectors spent $70 billion in 1985 [2] on software development compared to $230 billion in 2000 [3]. In 1992 DoD spent approximately $24 billion to $32 billion on software requirements. "Estimates also indicate that total annual software costs could increase to about $50 billion in the next 15 years, accounting for almost 20 percent of Defense's [DoD's] overall budget" [4:2]. DoD spending increases are due, in part, to a greater dependence on software to improve the warfighting capabilities of the warfighter. According to the former Deputy Under Secretary of Defense (Science and Technology), Dr. Delores Etter, "Software is pervasive. It truly is the new physical infrastructure. We are more dependent on software than ever, and software is becoming more complex" [5:3]. In this era of near continuous software capabilities expansion and defense force structure downsizing, software programs and instructions are relied upon to maintain our defense capabilities. Figure 1 shows this increasing software dependence in terms of the percent of functions performed by software in selected DoD weapon systems [6:54].

Weapon System	Year	Percent of Functions Performed in Software
F-4	1960	8
A-7	1964	10
F-111	1970	20
F-15	1975	35
F-16	1982	45
B-2	1990	65
F-22	2000	80

Figure 1. Increased Software Dependency [6:55]

Amid this increasing dependence, the need for increased management of software development costs was brought to center stage during the development of the McDonnell Douglas transport aircraft designated the C-17. In 1985, at the beginning of development, the estimated lines of code (LOC) needed for all C-17 software systems was 164,000. The actual figure would grow over the next five years of development to 1,356,000 LOC, making the C-17 "the most computerized, software-intensive, transport aircraft ever built" [7:2]. By May 1992, the program was estimated to be "2 years behind schedule and $1.5 billion over the 1985 program cost estimate of $4.1 billion" [7:14]. Pentagon officials became so concerned that in 1993 one of the program managers was fired, three other Air Force officials were given reduced punishment, and the program was targeted for cancellation [8].

This increased dependence on software highlights software development as a major cost driver in new weapon system development programs. Therefore, accurate software development cost estimates are essential to the Air Force for use in out-year budget formulation to ensure funds are available to pay for approved programs. The estimation problem is even more widespread as "27 percent of software development projects come in on time and on budget…" [9:13].

However, according to Ferens [10], DoD software cost analysts do not have adequate information about their software development projects to construct accurate software cost estimates. Boehm points out that cost estimate accuracy increases the closer the project gets to completion (Figure 2). In later stages of a software project, more accurate measures of estimation parameters, such as code size and personnel productivity, are available. Thus, the software effort and cost estimate ranges are reduced over time [11].

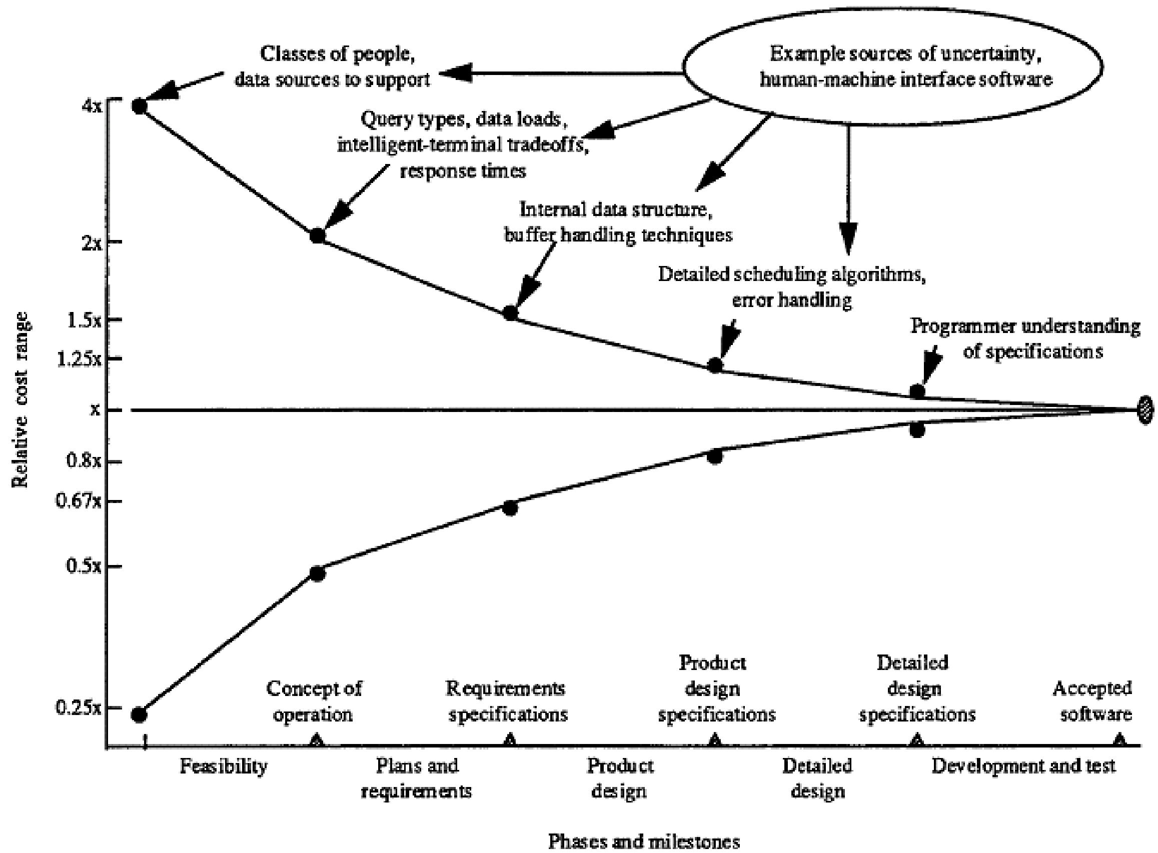


Figure 2. Software Cost Estimation Accuracy versus Program Phase [12:311]

Specific Issue

Software cost estimates are developed by different methods such as commercial parametric models, analogy, expert opinion, and bottom-up. The estimate could also be a

combination of one or more these methods. Each estimation technique has its own strengths and weaknesses. In general, all techniques build the cost estimate by developing a cost estimating relationship between project independent parameters (e.g., size, domain, etc) and dependent cost estimation values (e.g., effort, cost, and schedule).

Parametric models, the most widely used DoD technique to estimate software cost, relate multiple independent parameters with dependent variables via mathematical formulae. The mathematical formulae are developed using statistical procedures and a historical database of software project costs. Most parametric models in use today are proprietary. Thus, the mathematical formulae are not published for analysts to study and gain an understanding of how cost estimates are generated.

Cost analysts who utilize these proprietary parametric programs to construct a software cost estimate and who do not have some statistical educational background, do not understand the relative effects each parameter has on the cost estimate. However, this information is desirable to account for the uncertainty associated with the input parameter values. With this understanding, estimators could provide a more realistic cost estimate range rather than a misleading and frequently inaccurate point estimate.

Research Objective

The objective of this study is to determine the relative change of a cost estimate from a baseline estimate as parameter input values are altered from the lowest rating to the highest rating and size is held constant. The secondary objective is to use the results of the experiment to develop risk factors that will enable analysts to develop cost estimate ranges based on the uncertainty and impact of the subject parameter values.

Scope of Research

The Air Force Cost Analysis Agency has requested that this research utilize the following commonly used parametric models: COCOMO II, SEER-SEM, SLIM, and PRICE S. Personnel parameters will be the only parameters that will be adjusted. Other parameters will be set at the nominal setting. The size parameter will be set to 40,000 source lines of code.

Thesis Overview

Chapter II, Literature Review, summarizes the most current techniques used to incorporate risk into the cost estimate. Each parametric model will be reviewed for similarities and differences.

Chapter III outlines the methodology, Design of Experiments (DOE), to evaluate the selected parameters' effect on the cost estimate. Additionally, the process for calculating the calibration factors is explained.

Chapter IV, Findings and Analysis, presents the results of the DOE. These results are used to develop the risk factors.

Chapter V, Conclusions and Recommendations for Follow-up Research, explains whether or not the objectives were met. Recommendations for further research are given.

II. Literature Review

Introduction

This chapter summarizes the recent research on the software cost estimation process, cost estimation methods, and the current state of cost estimation. It covers parametric models that will be utilized to evaluate the impact of cost parameters other than size and identifies which model parameters to use in the design of experiment (DOE). The DOE procedures are described in the methodology chapter. The scope of the review is limited to the four parametric software cost estimation models: SEER-SEM, COCOMO II, SLIM, and PRICE S.

Software Cost Estimation

The Society of Cost Estimation and Analysis defines cost estimating as "the art of approximating the probable cost or value of something, based on information available at the time" [13: n. pag.]. Thus, software cost estimation is the process of approximating the cost of producing a software product. The process can have different designs depending on the type of software under development, but each process has the same basic structure.

Basic process.

The basic process of estimating software cost is 1) determine what work/effort must be performed at some productivity level; and 2) over what time to produce the software product. Effort is then expensed at some dollar rate to obtain the cost of the

product. Lawrence Putnam uses a simple generic mathematical formula to illustrate this relationship between product, effort, productivity, and time (see Eq. 1).

$$\text{Product} = \text{Productivity} * \text{Effort} * \text{Time} \qquad (1)$$

where Product = size of software (e.g., source lines of code (SLOC) or function points)

Productivity = "a measure of the amount of product produced per unit of human effort" [14:36]; measured in SLOC/manmonth

Effort = manmonths or manyears

Time = months or years [14:26-36].

The variables of the equation must be determined to solve for effort. The effort would then be multiplied by the budgeted labor rate to get the estimated cost. The estimator can employ a number of methods to produce the equation values: 1) analogy, 2) expert opinion, and 3) parametric models (15).

Analogy.

The analogy method uses information from previous projects. An analyst who uses this method knows that the new project is similar to the completed project(s). Final costs of projects with similar components or requirements, adjusted for design or complexity changes, would be used to develop the cost estimate for the new project. Detailed technical data is a requirement to ensure the analogous system is truly similar if this method is used (15). This method will not be used in the research effort since parametric model parameters are the focus.

Expert opinion.

Expert judgment techniques rely on data from one or more experts. Estimators must ensure that anyone asked to provide information has adequate knowledge and experience with the past projects and the new requirements to provide meaning information. For example, in the Delphi method experts are sent a questionnaire to answer. After the responses are returned to the originator, all the feedback is sent back out to the respondents. Responses are kept anonymous. Then the process is repeated. The estimate is refined as the iterations are completed until a final estimate is agreed on. The main point is to eliminate bias within the group setting. Expert opinion is not encouraged, however, due to inconsistency in the accuracy of individual estimates [1]. Therefore, expert opinion will not be considered in this research.

Parametric models.

Parametric models are the focus of this thesis. Parametric models are mathematical equations that have one or more inputs to generate the output. The inputs and outputs have been statistically proven to have independent/dependent correlations. That is to say the inputs, such as complexity or programmer capability, are the independent factors and outputs, such as cost or effort, are the dependent parameters.

Software projects have many different computer software configuration items (CSCIs) that make up the final software product. Each one of the CSCIs has an individual cost estimate that makes up the final project cost estimate. Parametric models have the benefit of speed because only a few inputs are needed based on the mathematical equation. Another advantage is the accuracy of the estimate. Parametric

estimates are as accurate as those estimates from other models, provided the models have been calibrated and validated. DoD prefers the parametric models given these benefits [1].

However, just using a parametric model does not guarantee accuracy. One study shows that the correct setting of the individual parameters is more important than using the correct model [16]. Four of the parametric models widely used by DoD personnel are Constructive Cost Model (COCOMO), Galorath Software Evaluation and Estimation of Resources Software Estimating Model (SEER-SEM®), Software Life-Cycle Model (SLIM), and Price Software Model (PRICE S®). These models' equations and input parameters will be described later in this chapter.

State of the practice.

The history of software cost estimation began with the software era in the 1940s. Cost estimation was performed manually with simple relationships and equations developed by individual companies. The need for improved software cost estimation grew as the software engineering field developed. Air Force, Army, Hughes Aircraft, IBM, RCA, and TRW funded research to learn what factors where driving software development costs [17].

Many parametric models were developed from the early research such as PRICE S, SLIM, COCOMO, SEER-SEM, and CHECKPOINT. As of 1998, there were at least 50 different models to choose from [17]. Over time many of the models have developed similar input parameters. Size has always been the dominating parameter, but other parameters include "program attributes such as domain, complexity, language, reuse, and required reliability; choices of computer attributes such as time and storage constraints

and platform volatility; choices of personnel attributes such as capability, continuity, and experience; and choices of project attributes such as tools and techniques, requirements volatility, schedule constraints, process maturity, team cohesion, and multisite development" [18:940].

Although the models have had many improvements and estimation features added, the accuracy of the model estimates are still questionable. Ferens reports on numerous studies performed for the DoD using many of the commercial software estimating models that 25 percent accuracy is the best that can be anticipated half of the time. The accuracy did not improve even after calibrating to a military data set. Ferens contends that DoD cost analysts cannot be expected to have accurate estimates since parametric models are more often than not the method utilized [10]. The study of risk analysis must be considered to understand why accurate cost estimates are important.

Risk

Nicholas states, "Every project is risky, meaning there is a chance things won't turn out exactly as planned. Project outcomes are determined by many things, some that are unpredictable and over which project managers have little control" [19:306]. These risks normally cause the cost of the project to increase. Air Force budget managers develop out-year budgets based on forecasted project expenditures. The forecasted project expenditures are developed based on the project cost estimate. Therefore, it is imperative that the project cost estimate capture a reasonable amount of the potential cost that the risks impose, because not including the risk costs would leave the project under funded should one of the risks occur.

Risk Analysis.

"Risk analysis is the quantifying, either qualitatively or quantitatively, of the probability and the potential impact of some risk" [20:1]. Risk analysis includes the following steps: "risk identification, risk assessment, and risk response planning" [19:307]. The project has to be broken down into manageable units before the risk analysis can be performed.

There are two ways to divide a project into component parts, process or product structure. In the case of an aircraft, the process structure would divide the project into the overarching phases such as requirements, design, development, test & evaluation, manufacturing, and operational support. Similarly, the product structure could be cockpit section, propulsion section, fuselage section, wings section, and tail section. These would be further divided unto the lowest division of work. The end result of either method is a Work Breakdown Structure (WBS).

The risks of completing each item can be determined systematically using the WBS. The risks are assessed for project impact and probability of occurrence to determine which risks should be focused on. Developing a plan to manage the risks is the last step in risk analysis; however, the risk assessment should be reevaluated periodically and used to develop the cost estimate.

Cost Risk.

Cost estimation, if performed correctly, includes the information obtained from the risk analysis. The initial cost estimate is developed by using the WBS and estimating how much each part will cost. This initial estimate is normally referred to as a point

estimate since it does not include the effects of risk. Cost risk is the cost impact if the risk event occurs. Coleman calls this "the funds set aside to cover predicted cost growth" where cost growth is the "increase in cost of a system from inception to completion" [21:4].

The point estimate is modified by including the risk analysis data for each WBS element. When the risk assessment is performed, possible outcomes are evaluated based on the impact to technical requirements, schedule, and cost and the probability of each outcome occurring. The cost ranges developed from the risk assessment along with the corresponding probabilities are incorporated into the estimate. Using Monte Carlo simulation techniques a range of cost estimates are generated with corresponding probability of occurrence [21]. (It should be noted that this process is more complicated than addressed here. It is not the intent of this paper to explain how the estimation process should be performed, but how it is linked with the risk analysis.)

Cost Estimation Risk.

Cost Estimating Risk is "risk due to cost estimating errors, and the statistical uncertainty in the estimate" [21:5]. The cost analyst uses the WBS to develop the project estimate. Project engineers or WBS element experts can be interviewed to determine the cost range and probabilities of occurrence. Historical data might also provide another source of information on the cost of a project. The risk exits that the analyst will make a mistake in determining the appropriate cost data to use in developing the estimate using either approach.

Software cost analyst depend mainly on commercial off-the-shelf (COTS) cost estimating tools such as COCOMO II, SEER-SEM, SLIM, and PRICE S. The analyst

needs very little data to be able to develop an initial estimate. Estimated size, complexity, development environment complexity, and personnel capabilities are some of the data needed to populate the estimating tool.

How the models input parameters affect the final estimate is important to understand to be able to develop proper risk adjusted estimates due to the dependence on COTS models. The Clinger Cohen Act requires a risk adjusted estimate for all information system projects [22]. The focus of this research is to determine the impact of three of the most frequently used COTS models to provide a foundation for risk ranges.

Software Cost Estimation Models

These model descriptions will only cover the development cost estimation process since the research is focused on the development costs.

COCOMO II.

Barry Boehm, a pioneer in software cost estimation, first started working on the COCOMO model in the 1970s as an engineer for TRW. This model has become the most widely used parametric model to date. The popularity is due to it being an open model since Boehm published all the equations, parameter level coefficients, and development details in his famous book *Software Engineering Economics,* in 1981 [12].

The current version, COCOMO II, was released in 2000. This version updates the database to 161 projects used to develop the parameter coefficients, adds some new effort multiplier parameters, and allows function point sizing. Three models are used to generate an estimate for the full life of the product: early prototyping phase, early design phase, and post-architecture phase [23]. This thesis will focus on the post-architecture model.

The post-architecture model is used when the product is ready for full scale development. Therefore, much of the needed detail, such as requirements and design, to characterize the product and construct an estimate are readily available. The formula used to calculate the effort in person-months is

$$PM = A \times Size^{E} \times \prod_{i=1}^{n} EM_i \qquad (2)$$

where
$A = 2.94$
EM_i = each effort multiplier not rated at nominal
$$E = B + 0.01 \times \sum_{j=1}^{5} SF_j$$

where $B = 0.91$
SF_j = each scale factor value

The three main inputs are effort multipliers (EMs), scale factors, and size. Size and scale factors will not be discussed since this research is holding the size parameter constant. Figure 3 shows the different factors that go into the COCOMO II effort estimate [23].

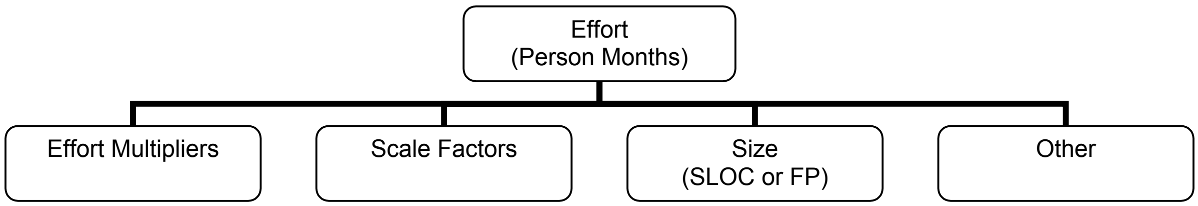


Figure 3. COCOMO II Effort Estimate Inputs

The effort multipliers are categorized into four groups: Personnel factors, Product factors, Platform factors, and Project factors. COCOMO's effort multipliers are used to explain the productivity of the development team which directly impacts the effort needed for the project. "After product size, personnel factors have the strongest influence in determining the amount of effort required to develop a software product" [23:47]. The impact of each effort multiplier is quantitatively expressed in Table 1. The value for analyst capability at the very low (VL) rating means the effort required will be 42% more than the base effort estimate when set at nominal (N). No other model openly explains all equations and model input relationships to this detail.

Table 1. COCOMO II Personnel Factors [23:47-49]

Personnel Factors		VL	L	N	H	VH	Productivity Range
Analyst Capability		1.42	1.19	1.00	0.85	0.71	2.00
Programmer Capability		1.34	1.15	1.00	0.88	0.76	1.76
Personnel Continuity		1.29	1.12	1.00	0.90	0.81	1.51
Applications Experience		1.22	1.10	1.00	0.88	0.81	1.51
Platform Experience		1.19	1.09	1.00	0.91	0.85	1.40
Language and Tool Experience		1.20	1.09	1.00	0.91	0.84	1.43

COCOMO's personnel factors are used to explain the ability and know-how of the development team as opposed to an individual on the team. Analysts that are rated high (H) will not expend as much effort to get requirements and design finished as compared to analysts that are rated low (L). Programmer capability is concerned with the "ability, efficiency and thoroughness, and the ability to communicate and cooperate" of the programmers as a team [23:47]. Personnel continuity evaluates the annual personnel turnover expected during the project. Applications experience rates the development team's experience with the application under development. For example, a low rating would be given if the team had less than two month's experience. Platform experience explains the team's knowledge of platforms like graphic user interface or networking. Language and tool experience takes into account the software development tools to be used on the project [23].

SEER-SEM.

"SEER-SEM is a tool for software estimation, planning and project control. SEER-SEM estimates software development and maintenance effort, cost, schedule, staffing, reliability, and risk" [24:Ch2,2]. This section describes the input parameters and equations used to generate the estimate outputs.

SEER-SEM utilizes knowledge bases to develop the initial estimate. "A knowledge base is a set of parameter values, based on actual project, requirement, and environmental data similar to your estimating scenario, which can be used to initialize parameter values in your WBS [work breakdown structure] elements" [24:Ch6,1]. The user selects the appropriate knowledge bases and inputs the size estimate, which gives the model enough information to calculate an estimate. All parameter values will be set to the nominal value if knowledge bases are not chosen when the project is created. The following is a list of the seven knowledge bases and their definitions:

1. **Platform -** explains where the software will be utilized, like aircraft, space or ships [24].

2. **Application** – explains the general use of the software; "Examples include: artificial intelligence (AI), computer aided design (CAD), command and control, communications, database, diagnostics, financial, flight, graphics, management information systems (MIS), mission planning, operating system/executive, process control, radar, robotics, simulation, and utilities" [24:Ch2,7].

3. **Acquisition Method** – explains how the software will be acquired, such as all new code, modification, rehosting, and others or some combination.

4. **Development Method** – "Describes the methods to be used during development, such as rapid application development (RAD), traditional waterfall, object-oriented, prototype, spiral, or incremental" [24:Ch2,7].

5. **Development Standard** – "Describes the documentation, reliability, and test standards to be followed such as ISO, IEEE, ANSI, military, informal, or none at all" [24:Ch2,7].

6. **User Defined** – "Describes special user-defined classifications of software" [24:Ch2,7].

7. **Component Type** – "(COTS only) Describes those parameters that are relevant to particular types of commercial software packages" [24:Ch2,7].

The user has the option of changing a knowledge base parameter value to a user specified value after SEER-SEM has calculated the initial estimate. This change in parameter value is done for each parameter where additional information is known about the project, such as language complexity or personnel capabilities. The parameter inputs represent qualitative factors about the software project. The rating scale is very low to nominal to very high, with some parameters having additional ratings such as extra high, nominal (+), or very low (–) [24].

The parameters are grouped according to the following four categories: sizing parameters, technology and environment parameters, other parameters, and Commercial Off-The-Shelf (COTS) parameters. The technology and environment parameters, see Figure 2 next page, are further divided into the following categories: personnel capabilities and experience, development support environment, product development requirements, product reusability requirements, development environment complexity, and target environment [24]. "In a sense, these parameters represent the productivity potential of the environment" [24:Ch2,3], which relates back to Putnam's general equation (1).

Figure 4 is a graph depicting the relative impact on cost and effort. Security requirements are shown to have the highest impact, while target system complexity has the smallest impact. The actual parameter impact values are not given.

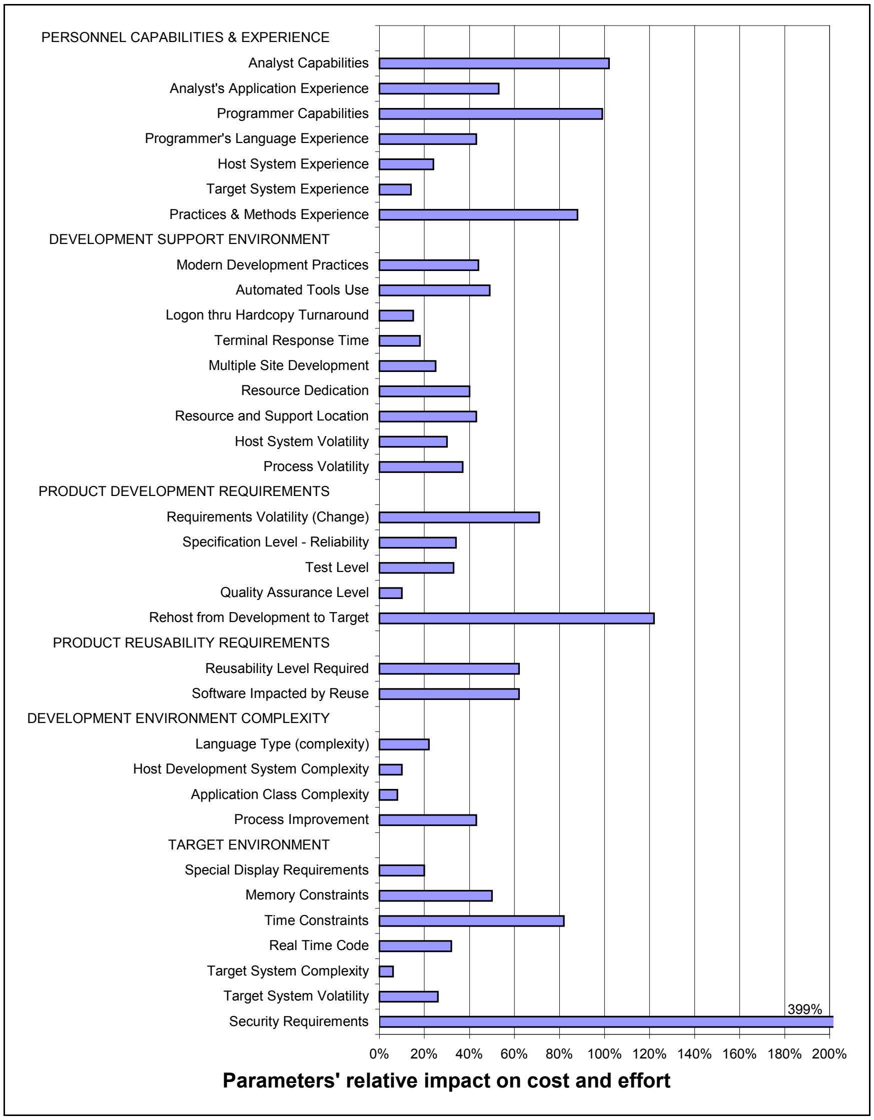


Figure 4. SEER-SEM Parameter's Relative Impact [24:Ch7, 18]

The mathematical equations and how they work will be explained in general terms since SEER-SEM is a proprietary model. SEER-SEM uses the following software equation:

$$S_e = C_{te}\sqrt{K t_d} \qquad (3)$$

where S_e = effective size (input)
C_{te} = effective technology (input)
K = effort (output)
t_d = schedule (output)

Size is input by the user. SEER-SEM calculates the effective technology constant from the qualitative parameter settings. The complexity equation (4) is required to solve for effort and schedule since there are still two unknown variables:

$$D = \frac{K}{t_d^{\,3}} \qquad (4)$$

where D = staffing complexity (input)

Staffing complexity is calculated by SEER-SEM from the user inputs. The software equation is solved for t_d (5) and substituted (6) into the complexity equation (4).

$$t_d = \frac{S_e}{C_{te}\sqrt{K}} \quad (5) \qquad D = \frac{K}{\left(\frac{S_e}{C_{te}\sqrt{K}}\right)^3} \qquad (6)$$

Effort (K) is the only unknown equation (6),. Therefore, effort can be solved:

$$K = D^{0.4}\left(\frac{S_e}{C_{te}}\right)^{1.2} \qquad (7)$$

Schedule can be calculated by replacing effort in the software equation with equation (7) now that one unknown is solved. Schedule would equal

$$t_d = D^{-0.2}\left(\frac{S_e}{C_{te}}\right)^{0.4} \qquad (8)$$

SLIM.

"SLIM-Estimate 5.0 is a powerful management tool for estimation, analysis, and presentation of software project schedule, effort, and quality data" [25:2]. Lawrence Putnam, author and creator of the Software LIfecycle Model (SLIM), views estimating as "a means of projecting the amount of work that has to be performed over a period of time to produce a product" [14:26]. This relationship between work performed (effort), time, and the desired product is held together by the productivity of the team performing the work, as shown earlier in equation (1) [14].

Putnam further explains that productivity is not merely source lines of code per man month as normally measured. Putnam believes the productivity of the software development process is what truly impacts effort required to develop a software program. Therefore, the productivity factor and size estimate have the most impact on calculating the effort in the SLIM model [25]. This process productivity is characterized by management practices, advanced programming language in use, advanced tools and equipment usage, team skills and experience, and "complexity of the application type" [14:27]. Process productivity is captured by the Productivity Index (PI) in the SLIM model.

The SLIM user has the option of one of two processes: Quick Estimate Wizard and Detailed Input Method, to develop an estimate. The Quick Estimate Wizard is used to generate an initial estimate when very little is known about the development project. The Detail Input Method would be used to further characterize the project after additional information is obtained. The Detail Input Method could be used initially if the project is

far enough along in the development cycle. Project Environment and Solution Assumptions are the main input areas need to develop the initial estimate.

The Project Environment screen Project Description tab, Figure 5, allows development characteristics to be input such as Application Type and Application Type mix. SLIM uses Application Type and Application Type % to calculate the default PI available to the project. SLIM has nine application types: Microcode, Real Time, Avionic, System Software, Command & Control, Telecommunications, Scientific, Process Control, and Business. The remaining tabs on this screen have default settings that do not need inputs for an initial estimate.

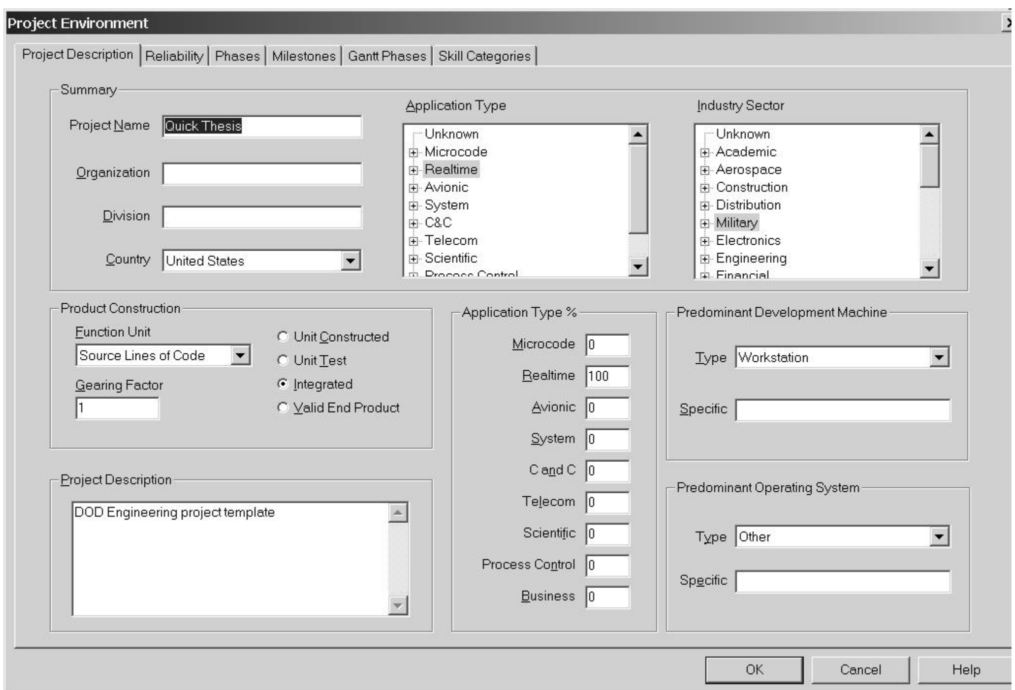


Figure 5. SLIM Project Environment Input Screen [25:22]

Solution Assumption inputs are the next required data, Figure 6. These inputs include Basic Info, Phase Tuning, and Accounting. The Basic Info tab allows the user to input start date, phases to include in the estimate, staffing buildup, estimated size of the

project, and PI. Many of the fields are pre-filled with SLIM defaults. The minimum inputs needed to generate an estimate are the start date, size information, and PI.

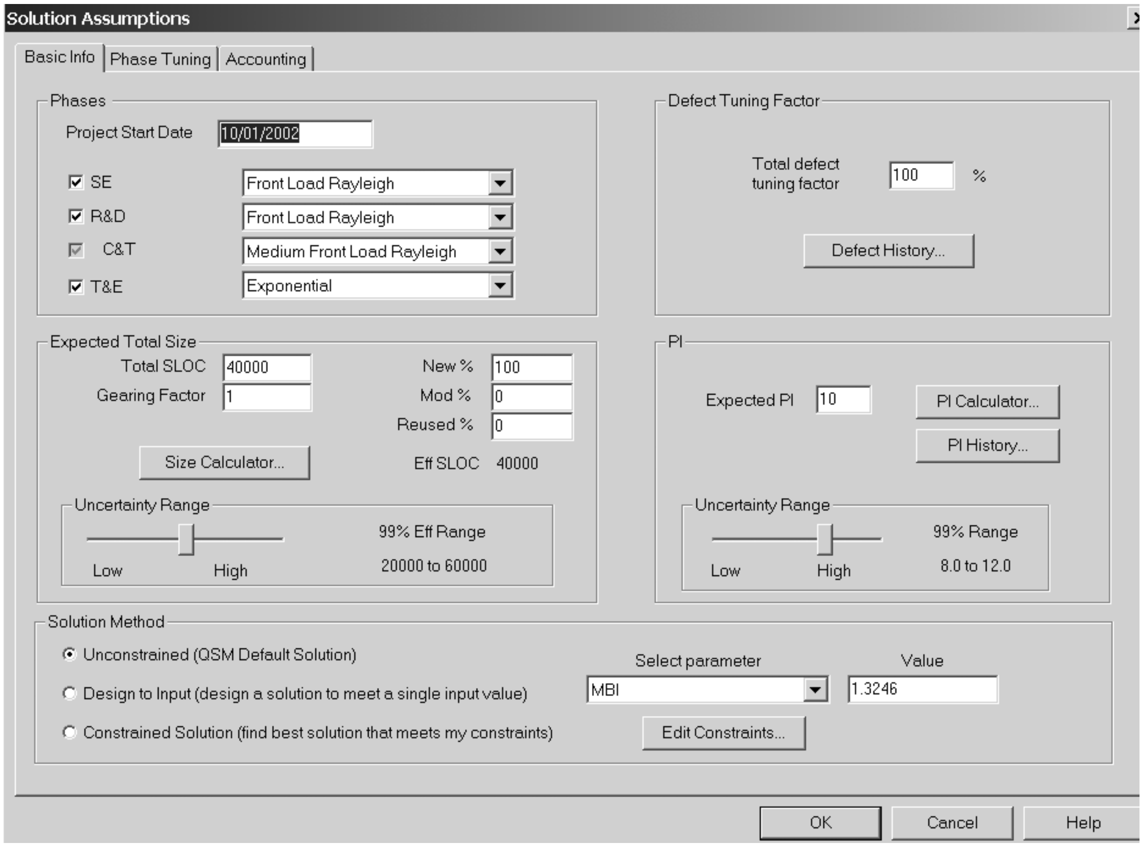


Figure 6. SLIM Solution Assumptions Input Screen [25:24]

The default PI, based on the size estimate and development complexity, is calculated using a historical database of over 5,000 projects. The development complexity that impacts the PI is divided into three areas: tooling and methods, technical difficulty, and personnel factors. These areas can be rated at an aggregate or detail level as shown in Figure 7, default PI Calculator and Figure 8, PI Detail. The rating scale is from 0 to 10 with 5 being an average score. These complicating factors each have an equal impact on the PI.

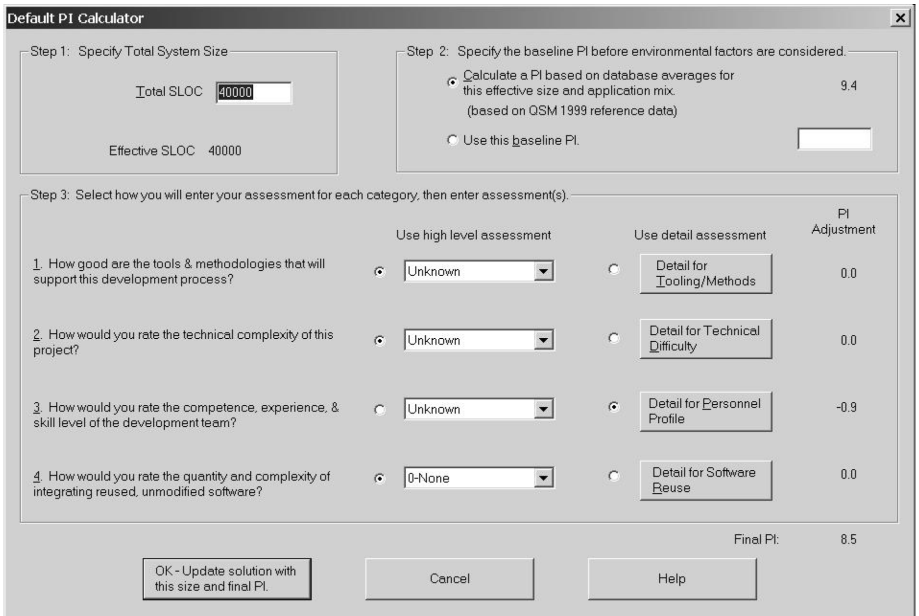


Figure 7. SLIM Default PI Calculator [25:102]

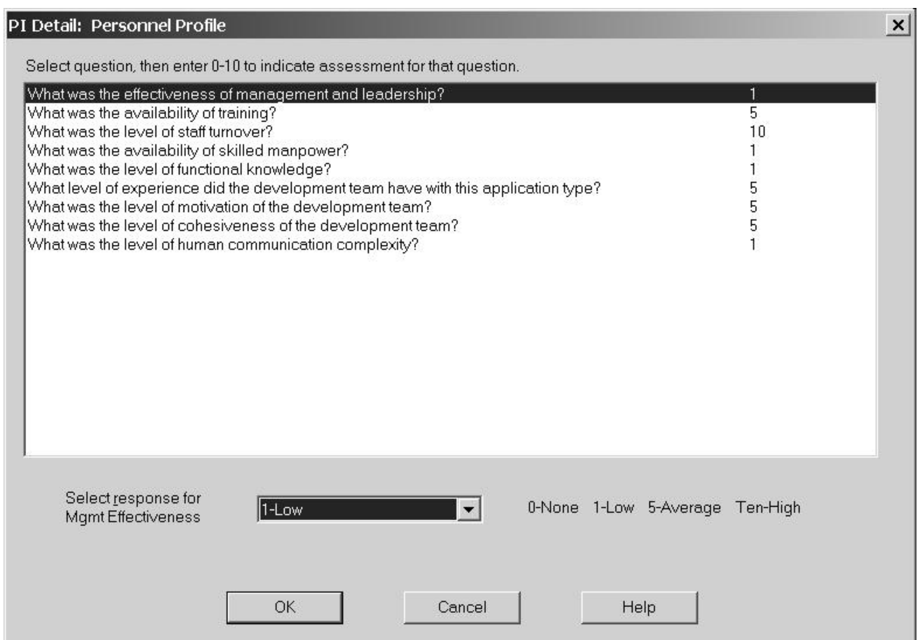


Figure 8. SLIM PI Detail: Personnel Profile [25:104]

PRICE S.

The PRICE S model calculates cost and schedules for software development projects. Even though the model has parametric equations, the company takes pride in the fact that the model does not depend strictly on statistical relationships to develop an effort estimate. The model was developed to allow the analyst to use valuable experience when characterizing the development team. PRICE S does not rely on one parametric equation or single data base. Instead, inputs capture aspects of the software development process that affects effort [26].

The model was first built with regression analysis and then enhanced to allow the analyst to include experience based opinion that tailors the model to the analyst's company. Effectively creating different equations for each project as the analyst calibrates the model. Figure 9 is a representation of the PRICE S model parameter relationships. Productivity (PROFAC), Volume, and Complexity (APPL) make up the core equation. Complicating factors are then introduced to determine the additional effort required to complete the development [26].

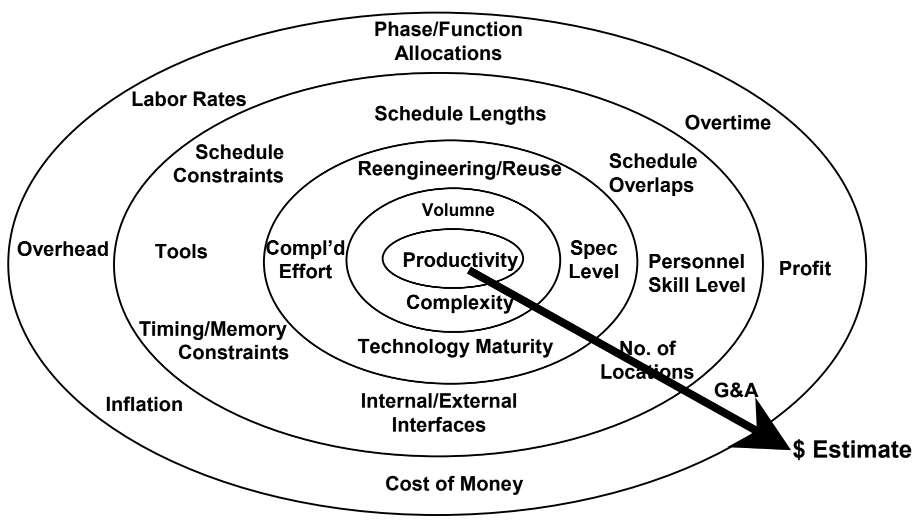


Figure 9. PRICE S Equation Relationships [26:167]

"PROFAC is an empirically derived parameter that includes such items as skill levels, experience, productivity, and efficiency" [26:119]. This value is determined by PRICE S using completed projects of the company or PRICE S industry standard values, Figure 10. Type of platform under development is determined first if PRICE S values are to be used.

Platform "is a measure of the transportability, reliability, testing, and documentation which must be provided for acceptable contract performance" [26:18]. Platform categories are Commercial Proprietary Software, Commercial Production Software, Military Software, and Space Software with values ranging from 0.6 to 2.5 respectively [26].

Next, the PROFAC values are associated with each Platform value as shown in Figure 6. Each grouping has a high, nominal, and low setting. For example, airborne military software platform value is 1.8. Therefore, the PROFAC range would be 5.5 to 6.5. The PROFAC would be 5.0 if the organization's personnel experience was nominal [26].

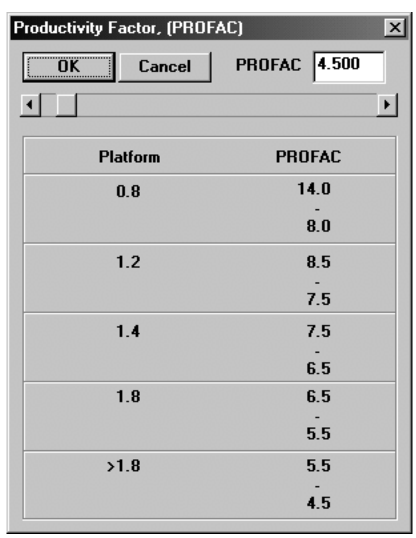


Figure 10. Productivity Factor Table, PROFAC [26:168]

The software volume value of the project under development is the product of size, a function value of language type, and APPL, Figure 11. Price Systems uses Volume to describe the total amount of work that must be completed. Size can be input as source lines of code, function points, or predictive object points. APPL describes the complexity of the software under development based on what functions the actual code will be performing.

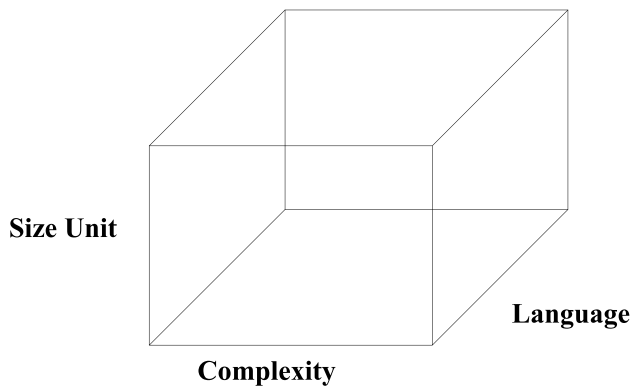


Figure 11. Price Software Volume [26:169]

The APPL value is entered using the APPL Generator, Figure 12. The value can be entered by the user based on experience or historical data or calculated by PRICE S based on a percent of each

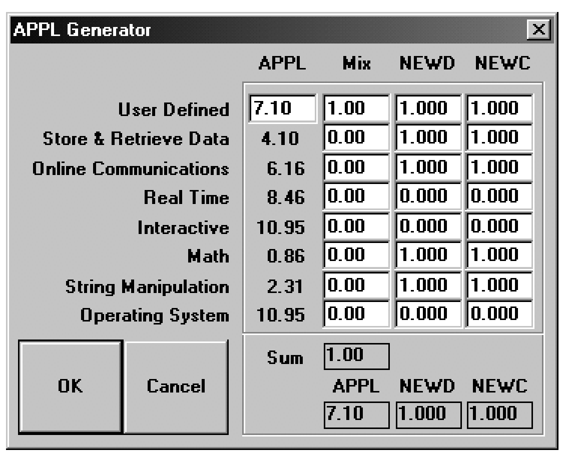


Figure 12. Price S Application Mix Generator Form [26:123]

type of functionality in the development such as 20 percent Online Communication, 10 percent Math, etc where the sum must equal 100 percent. Price Systems provides a table of APPL values, Appendix 6, which can be used to choose an APPL value for many different types of applications since some of the code functionality is not listed in the APPL generator.

PRICE S uses a core equation to calculate the labor hours (LH) required to complete the development if no other complicating factors were introduced now that Productivity, Volume, and Complexity have been determined. The core equation [26:171] is

$$LH = \frac{e^{PROFAC} * \left[VOL^{f(PROFAC)}\right]}{1000} \qquad (9)$$

Figure 13 shows the relationship software volume has to labor hours at different levels of organizational productivity. It is intuitive that the more software functions to produce or volume required more effort is needed. The graph also indicates that the more productive the personnel are less effort will be required to complete the task.

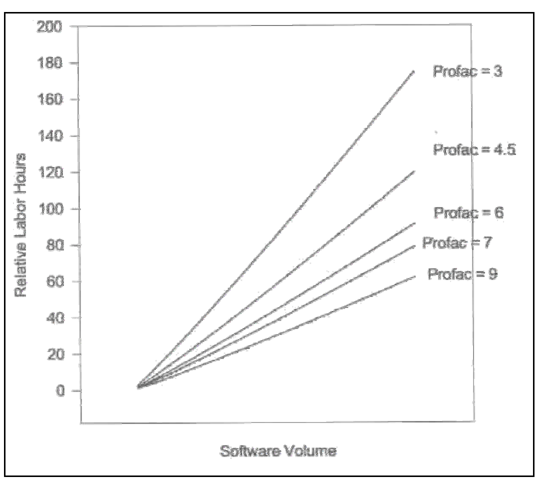


Figure 13. Software Volume vs. Labors Hours [26:171]

Now that the core labor effort has been estimated, additional parameters are input that will adjust the core estimate. PRICE S parameters are not explicitly categorized as project, personnel, or product parameters as COCOMO and SEER-SEM. The parameters are more software development process oriented. This thesis is concerned with the personnel parameters. PRICE S has three personnel parameters: PROFAC, Complexity 1 (CPLX1), and Management Complexity (CPLXM) [27].

PROFAC is a historical rating using the PRICE S database or PRICE S calibrated value. CPLX1 differs from PROFAC by evaluating personnel skills, product familiarity, software tool usage, language experience, and requirements volatility. CPLX1 has a linear effect on labor hours, Figure 14. The equation [26:184] is

$$LH_{CPLX1} = LH_{(CPLX1=1)} * (.763 * CPLX1 + .237) \quad (10)$$

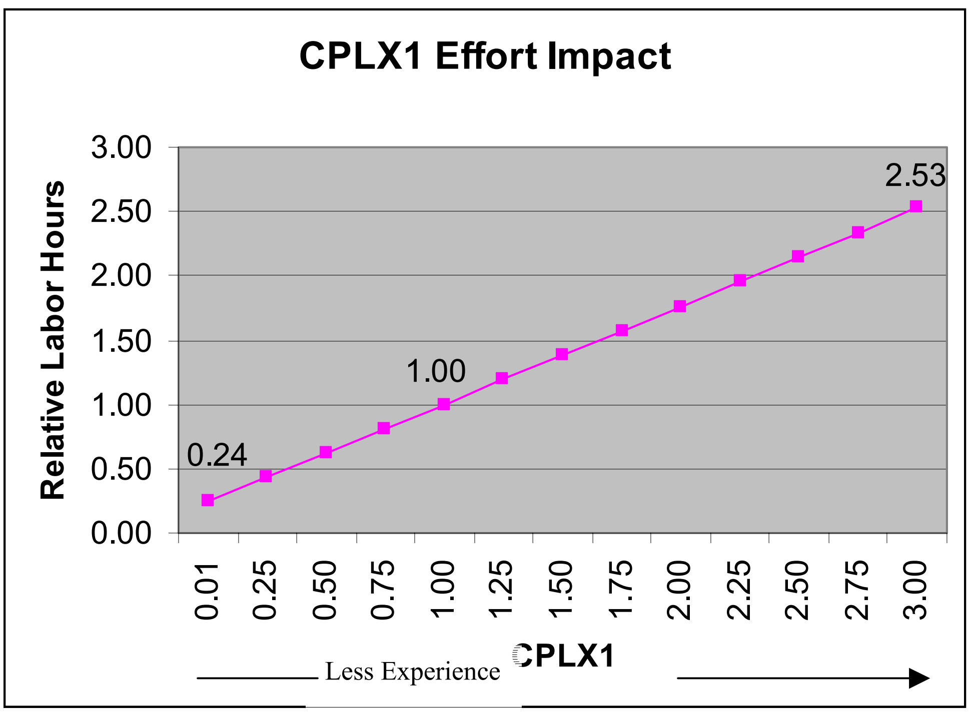


Figure 14. CPLX1 Labor Hour Impact Graph [26:184]

"CPLXM is used in PRICE S to model the effects of management complications, such as multiple development locations or multinational projects, on the cost of a software development" [26:187]. The more complex the management scenario the more effort required to ensure communication is maintained between the customer and the development staff. Figure 15 shows the linear impact of CPLXM on the effort estimate. The labor hour equation [26:188] for CPLXM is

$$LH_{CPLXM} = LH_{(CPLXM=1)} * (.3172 * CPLXM + .683) \quad (11)$$

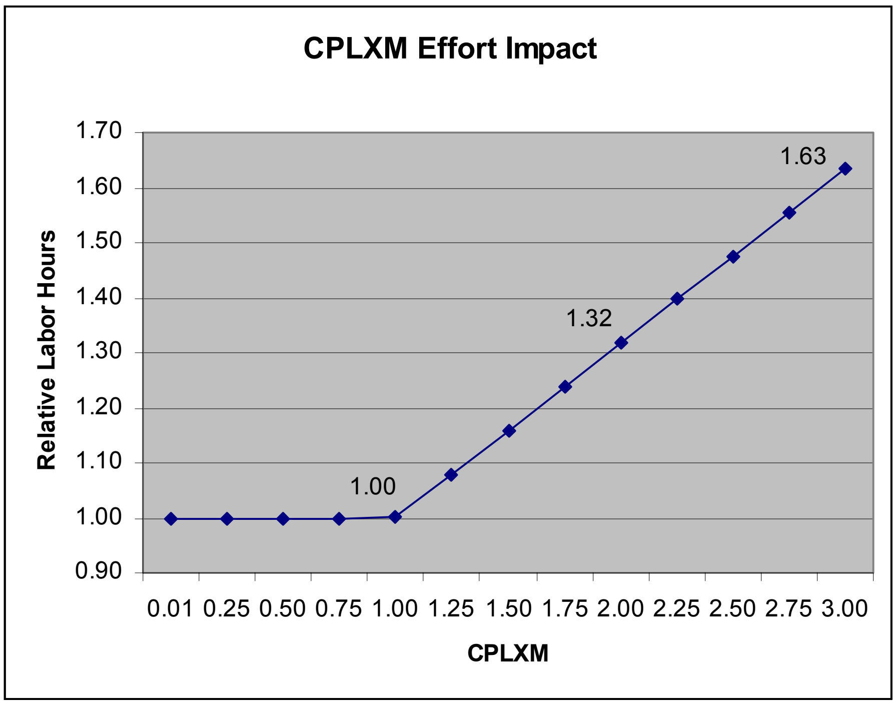


Figure 15. CPLXM Labor Hour Impact Graph [26:188]

Design of Experiments (DOE)

The research methodology used to gather data is Design of Experiments (DOE). DOE is a scientific method that systematically allows the researcher to collect unbiased data about a process under study. "A designed experiment is a test or series of tests in which purposeful changes are made to the input variables of a process or system so that we may observe and identify the reasons for changes in the output response" [28:1]. This research will involve six factors at three different levels for a total of 729 data points. Thus, a factorial design will be developed to account for all possible combinations of factors and levels used in the process.

The process in this research is software cost estimation, Figure 16, using parametric models. Some of the inputs to the process are product requirements, personnel factors, product size, and development environment complexity. The output variable is effort in man months. It is important for the cost estimator to know the impact that each input variable has on the output variable to be able to correctly characterize the development team and produce an accurate estimate. Additionally, when estimates are verified by a different parametric model, knowing how the input affects the effort output will allow the estimator to evaluate the differences in the two estimates.

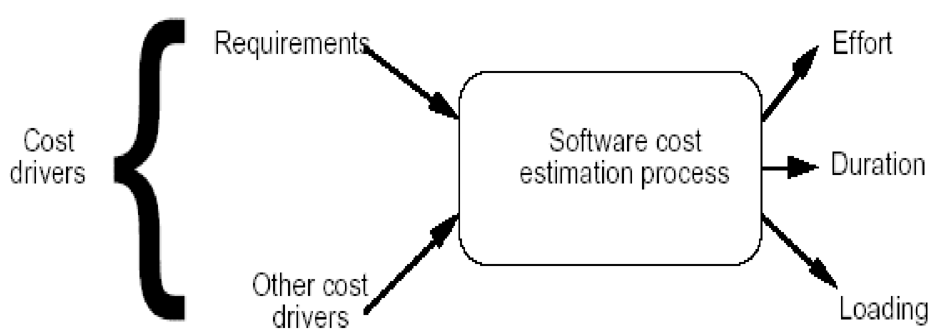


Figure 16. Software Cost Estimation Process [29:19]

III. Methodology

Introduction

The objective of this study is to determine the relative change of a cost estimate from the baseline estimate as the personnel parameter input values are altered from the lowest rating to the highest rating while size and other parameters are held constant. The secondary objective is to use the results of the experiment to develop risk factors that will enable analysts to develop cost estimate ranges based on the uncertainty and impact of the subject parameter values. Design of Experiments (DOE) will be used to collect COCOMO II, SEER-SEM, SLIM, and PRICE S effort data for analysis. The data will be analyzed for change in effort, generalization of parameter effects, range of impact, and linear or non-linear impact.

DOE

COCOMO II has 17 effort multipliers in the Post-Architecture model. The effort multipliers are categorized into four groups as shown in Figure 17. Collecting all the possible combinations between all 17 factors at the lowest and highest setting would take 131,072 trials. The trials would increase to 129,140,163 with three settings. Therefore, the number of factors in the experiment will be limited to an acceptable amount of trials.

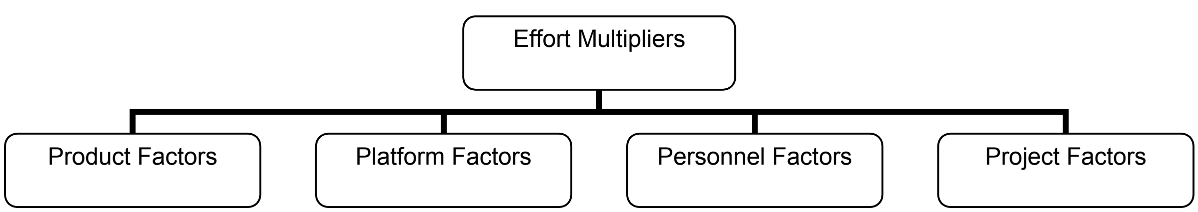


Figure 17. COCOMO II Effort Multiplier Groups

Boehm reports that personnel factors have the greatest impact on estimated effort after size [23]. The SLIM model documentation also indicates that productivity factors have the most impact on calculating the effort after size [25]. SLIM's productivity factor subsumes nine different personnel parameters. Therefore, this research will concentrate on the personnel inputs from each of the four models.

The COCOMO II model uses six parameters to characterize the personnel influences. These parameters at three different settings will generate 729 different possible combinations. With the exception of PRICE S, each of the models has at least six personnel parameters. Some of the personnel factors, Table 2, will have to be eliminated from the research to enhance cross model validation and arrive at a manageable trial size. The personnel parameters from SEER-SEM and SLIM will be compared to the other models. Any parameter not in one of the other models will be excluded from the research. The parameters not included will be SEER-SEM, Practices & Methods Experience; and Questions 2, 7, and 8 in SLIM. Personnel parameters not included in the research will be set to their nominal values.

Table 2. Model Personnel Parameters

COCOMO II	SEER-SEM
Analyst Capability	Analyst Capabilities
Programmer Capability	Analyst's Application Experience
Personnel Continuity	Programmer Capabilities
Applications Experience	Programmer's Language Experience
Platform Experience	Host System Experience
Language and Tool Experience	Target System Experience
	Practices & Methods Experience

SLIM
Question 1: How good is management and leadership on this project (0-10)?
Question 2: What is the availability of training (0-10)?
Question 3: What is the anticipated level of staff turnover (0-10)?
Question 4: What is the availability of skilled manpower (0-10)?
Question 5: What is the level of functional knowledge (0-10)?
Question 6: How experienced is the development team with this application type (0-10)?
Question 7: How motivated is the development team (0-10)?
Question 8: How cohesive is the development team (0-10)?
Question 9: What is the level of human communication complexity (0-10)?

PRICE-S
Productivity Factor
Complexity (Personnel Skills/Tools)
Management Complexity

Research Scenario

The experiment was conducted using an unmanned space development scenario. The software to be developed will be for a single CSCI. Code will be written to control a signal processing unit. The code will be 100 percent new developed code eliminating the complexity of reuse code in the estimate equation. The language utilized will be Ada 95. The quality standard imposed on the development project will be ANSI J-STD-016 Nom. Estimated size of this software development will be 40,000 SLOC. This scenario, Table 3, will be used to provide the models with initial inputs. Model parameters not using this information will be set to the nominal setting.

Table 3. Experiment Software Development Scenario

Unmanned Space
Signal Processing
New Development
Ada 95
ANSI J-STD-016 Nom
Size – 40,000 SLOC
Waterfall design

Data Collection

The data will consist of 729 individual runs, a full 3^6 factorial design for each model except PRICE S. PRICE S data will consist of 27 data points, a full 3^3 factorial design. A fractional factorial design will not be performed because the capability to batch process three of the models exists. SLIM data will be collected manually since it does not have batch processing capability. The batch processing is performed using Excel and Visual Basic for Applications (VBA). However, each model's process is different and will be explained. The VBA coding will not be explained in detail, but is provided in the appendix section.

COCOMO II.

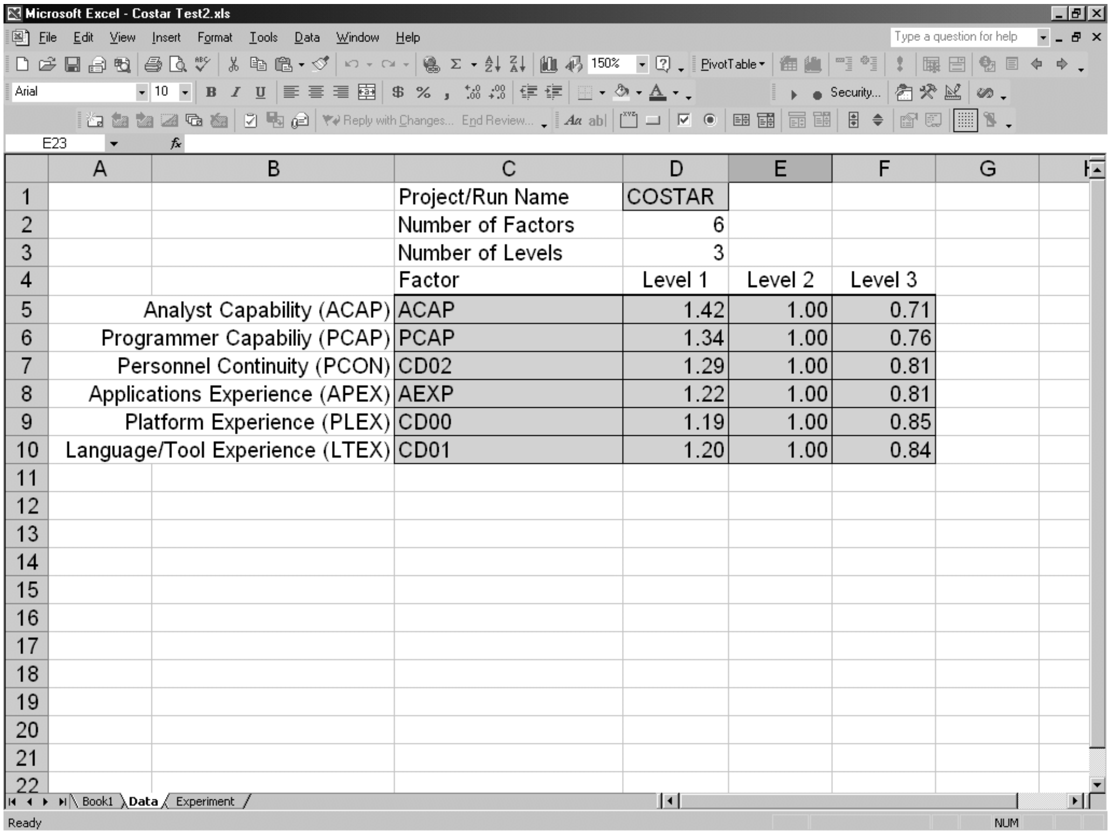
The COCOMO II software cost estimation software provided with Boehm's book, Software Cost Estimation With COCOMO II, does not have batch processing capability. However, Softstar Systems offers a software program that does have batching capability which can be calibrated to 13 different COCOMO models which included COCOMO II. Therefore, the COCOMO II data will be collected using the Softstar Systems software called Costar, version 6.05. The Costar initial input settings are provided in Table 4.

Table 4. Costar Initial Inputs

COSTAR	
Model Type	COCOMO II 2000
Phases	Waterfall
Size	40,000 SLOC
Effort Unit	Man Months
Scale Factors	
Precedentedness	Somewhat unprecedented
Development Flexibility	Some Relaxation
Architecture/Risk Resolution	Often 60%
Team Cohesion	Basically Cooperative
Process Maturity	SEI CMM Level 2
Effort Multipliers	Post-Architecture

Softstar Systems provides an Excel VBA file, Appendix 1, and Costar commands text file, Appendix 2, that allows the user to change the setting of one parameter at a time. To use the Excel file, the Costar VBA code will be modified to allow multiple parameter changes. The modified VBA code is located in Appendix 3. This code allows six parameters to be changed through 3 different settings and record each runs development effort estimate into the Excel file "Experiment" worksheet.

Module one will create the DOE matrix of all 729 trials in the Costar required format and command text. The parameter command names and command setting levels are first entered into the "Data" worksheet as shown in Figure 18. The levels can be entered in as numeric values or alpha command codes. Once the parameters and levels are entered, the macro CreateCostarExperimentMatrix is run. Module one will create the matrix in the "Experiment" worksheet. Module 2, docostar subroutine, is automatically started after Module one is executed.



	A	B	C	D	E	F
1			Project/Run Name	COSTAR		
2			Number of Factors	6		
3			Number of Levels	3		
4			Factor	Level 1	Level 2	Level 3
5		Analyst Capability (ACAP)	ACAP	1.42	1.00	0.71
6		Programmer Capabiliy (PCAP)	PCAP	1.34	1.00	0.76
7		Personnel Continuity (PCON)	CD02	1.29	1.00	0.81
8		Applications Experience (APEX)	AEXP	1.22	1.00	0.81
9		Platform Experience (PLEX)	CD00	1.19	1.00	0.85
10		Language/Tool Experience (LTEX)	CD01	1.20	1.00	0.84

Figure 18. Costar Modified Excel file "Data" worksheet

Module two uses the array table of parameters and settings on the "Data" worksheet, Figure 18, to write a "Costar.cmd" file which interfaces with the Costar software. The command file generates a Costar report file of the effort estimate. The original Costar VBA code is written to collect the total project effort estimate. Total project effort estimate is located on line 17 of the generated report. Line 17 is referenced in the VBA code as follows:

```
'   Read Costar results
'
Open tempdir + "costar.out" For Input As #1

For i = 1 To 17
  Input #1, mystring
Next i
```

This code will be modified to capture only development costs by changing the 17 to 15. This tells the VBA code to read the 15th line on the report instead of the 17th line. Module 2 will collect all 729 runs one after the other.

SEER-SEM.

"SEER-SEM has the capability to execute a stream of commands, either from the clipboard or a text file" [24:15-7]. This capability is called Server Mode by SEER-SEM. The clipboard procedures will be utilized for this research. Procedures can be found in the 2000 user's manual page 15-8 and Appendix B. Also, the SEER-SEM software provides an Excel file[1] which has instructions, sample script, and required command text for running the Server Mode option.

Clipboard option works by first developing the command strings. The command strings are then copied to the clipboard. The estimate can then be determined by running the command string through SEER-SEM by selecting from the main menu "File" then "Execute Clipboard".

The command string is developed using VBA code located in Appendix 4, module 1. The Excel file must contain two worksheets named "Data" and "Experiment" to create the command string. "Data" worksheet is where the parameter names and setting values required by Server Mode are entered. The VBA code then creates the command string for 729 different runs, names the text export file where the effort estimate data will be saved, and names the project file for future reference. Module 2 will be used to format the experiment matrix and copy the command string to the

---

[1] C:\SEER\SEM6-0\SEER-SEM Server Mode Details V6.0e.xls

clipboard. The effort estimate data has to be retrieved manually from the text export file to be analyzed. Table 5 provides the initial inputs to SEER-SEM.

Table 5. SEER-SEM Initial Inputs

SEER-SEM	
Platform Knowledge Base	!No Knowledge
Application Knowledge Base	!No Knowledge
Acquisition Method Knowledge Base	!No Knowledge
Development Method Knowledge Base	!No Knowledge
Development Standard Knowledge Base	!No Knowledge
Size	40,000 SLOC

SLIM.

The SLIM model does not have the capability to batch process each different parameter combination. Therefore, the data will be collected by inputting the initial settings, Table 6, for

Table 6. SLIM Model Initial Inputs

SLIM	
Effort Unit	Man Month
Application Type	Realtime
Industry Sector	Military
Product Construction	
Function Unit	SLOC
Radio Button Selection	Integrated
Gearing Factor	1
Application Type %	Realtime: 100%
Predominant Development Machine	Workstation
Predominant Operating System	Other
Default PI Calculator	
Step 1	40,000
Step 2	Calculate a PI
Step 3	
1. Tools & Methodology	Unknown
2. Technical Complexity	Unknown
3. Personnel Profile	Detail for Personnel Profile
4. Reuse	None
Schedule and Cost	Equal

the baseline scenario. Then the SLIM experiment matrix will be followed changing one parameter setting at a time and recording the effort estimate for analysis. The VBA code used to create the experiment matrix is located in Appendix 5.

PRICE S.

PRICE S uses a special Excel file to batch process multiple parameter changes. The file is located under the program group named PRICE Solutions. This file allows Excel to interface with the PRICE software to update a PRICE estimate.

The initial PRICE S file is created with the unmanned space scenario. Table 7 has the initial model inputs. PRICE S uses three parameters to evaluate personnel factors, therefore only 27 different trials are possible. Each trial will be created in one PRICE S file by creating 27 different Computer Software Configuration Items (CSCIs). The estimated effort at the CSCI level will be evaluated to determine the impact of each parameter. Due to the simplicity of this DOE, no VBA coding will be utilized.

Table 7. PRICE S Initial Inputs

PRICE S	
Development Processes	Waterfall
Start Date	303
27 Develop CSCIs each with a Language CSC - one for each trial	
Develop CSCI	
PLTFM	2.0
UTIL	0.5
Design Start	1102
Language CSC	
Lang	Ada 95
Size Unit	SLOC
Size	40,000
APPL	
User Defined	7.1
Mix	1.0
NEWD	1.0
NEWC	1.0

Data Analysis

The data for each model will be analyzed separately to determine the impact each parameter has on the effort estimate at the lowest and highest setting. The nominal effort estimate will be the initial baseline. The following formula will be used to determine the change from nominal:

$$Multiplier = 1 + \left(\frac{X_n - X_{Nom}}{X_{Nom}} \right) \quad (12)$$

where X_n is Effort estimate of the nth trial

X_{Nom} is Effort estimate where all personnel parameters are set at the nominal setting (baseline estimate)

Effort multipliers are determined for each parameter setting by locating each trial that has all the levels set at nominal save one after the impact of each combination of parameter settings is calculated. For example, to find the multiplier for Analyst Capability at the lowest skill setting in the COCOMO II trials, the trial run settings would be ACAP, 1.42; all other parameters would be set to the nominal value of one. The effort multiplier will be a fixed value if the model uses linear multiplication in the effort estimate equation to account for the parameter impact on the effort estimate.

Boehm used linear multiplication in the COCOMO estimation equation. The effort multipliers used in COCOMO are fixed for the given qualitative settings. This assumption that multipliers do not change is grounded in Boehm's belief that the impact of each cost driver is independent of the other cost drivers. Linear interpolation can be implemented to derive a value between the published values given this independence [23].

Independence between the cost drivers will be determined by changing the baseline effort estimate (X_{NOM}) used to calculate the initial multipliers. The new baseline will be the first cost driver used from each model, set at the highest skill level, while the rest of the cost drivers are set to the nominal value. For example, the original X_{NOM} for the COCOMO II data is the effort estimate from COSTAR trial 356, all cost drivers set to the nominal value. The new X_{NOM} used for the independence test will be COSTAR trial 608. For each parameter, independence will be shown if the new effort multipliers do not change from the original effort multipliers given the new baseline. This test will allow the multiplier to be generalized beyond the cost scenario developed to collect the current data.

Range impact of each parameter will be determined after the multiplier is calculated. The range information will provide the cost analyst the knowledge of which personnel parameter has the most impact to effort. The analyst's main focus should be placed on the accurate estimates for parameters that impact effort the greatest. Also, effective risk ranges could be developed based on the parameter impact values should the analyst not be able to obtain an adequate parameter estimate to include in the cost estimate model.

The last item to check for is linear or nonlinear effects of the personnel parameters as a whole. Three levels were included in the research to determine linearity. Linearity or nonlinearity will be determined by graphing the effort multipliers at the different skill levels.

IV. Results

Chapter Overview

Effort month data was collected from each of the parametric models COCOMO II, SEER-SEM, SLIM, and PRICE S. 729 data points were collected from each model except PRICE S, which had only 27 data points. The data was analyzed to determine impact multipliers, independence of parameters, impact range, and linear/nonlinear impact. COCOMO II data was analyzed first to determine if the methodology could recreate the COCOMO II published personnel parameters' effort multipliers. The process was repeated for each of the other three model's results once the methodology was confirmed adequate to calculate COCOMO's effort multipliers.

SEER-SEM appears to use linear multiplication personnel effort multipliers in its equations in a similar fashion as COCOMO II. However, SLIM and PRICE S use nonlinear calculations for including the personnel parameter impact on the effort estimate.

Individual Model Results

COCOMO II.

Boehm published the equations, equation coefficients, and theory for the COCOMO II model in the book *Software Cost Estimation with COCOMO II* [23]. Therefore, there is no surprise in how the personnel parameters impact the effort month calculation. The baseline effort estimate is 169.90 man-months. The personnel parameters with the most impact to effort are Analyst Capability and Programmer Capability. The personnel group productivity range is 16.90. 90 percent of the effort

multipliers fell between 0.45 and 2.26. The effort multipliers can be used as risk factors as suggested by Boehm [23]. The raw COCOMO II data from each trial is located in Appendix 7.

Effort Multipliers.

COCOMO II uses effort multipliers to characterize how cost drivers will impact the development effort. The post-architecture model is used to calculate the estimate for the development and maintenance stage of the software project. The product of the effort multipliers is multiplied by the nominal effort estimate to calculate the project effort estimate. The nominal effort estimate is calculated with all effort multipliers set to nominal rating, a value of 1.00. Linear interpolation between effort multiplier values is acceptable for the majority of the multipliers [23].

The nominal development effort estimate generated from the initial inputs from Table 3 is 169.90 person-months. The effort multiplier for each trial was calculated using the formula

$$Multiplier = 1 + \left(\frac{X_n - X_{Nom}}{X_{Nom}} \right) \quad (12)$$

where X_n is effort months of the nth trial and X_{Nom} is nominal effort months.

The effort for each cost driver at the three different levels was determined by locating the trials where all the parameter values were set to the nominal rating except the parameter level to be determined. For example, trial 608 was used to determine the multiplier value for Analyst Capability at the highest skill level. Table 8 shows each trial used to determine the multiplier values for each level. The same sequence of trials was used to analyze each of the other models' data. The calculated multiplier values were the

Table 8. COSTAR Trials For Multiplier Calculation

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Multiplier
Costar 122	1.42	1	1	1	1	1	241.20	1.42
Costar 284	1	1.34	1	1	1	1	227.60	1.34
Costar 338	1	1	1.29	1	1	1	219.10	1.29
Costar 356	1	1	1	1.22	1	1	207.20	1.22
Costar 362	1	1	1	1	1.19	1	202.20	1.19
Costar 364	1	1	1	1	1	1.2	203.90	1.20
Costar 365	1	1	1	1	1	1	169.90	1.00
Costar 366	1	1	1	1	1	0.84	142.70	0.84
Costar 368	1	1	1	1	0.85	1	144.40	0.85
Costar 374	1	1	1	0.81	1	1	137.60	0.81
Costar 392	1	1	0.81	1	1	1	137.60	0.81
Costar 446	1	0.76	1	1	1	1	129.10	0.76
Costar 608	0.71	1	1	1	1	1	120.60	0.71

same as the COCOMO II published personnel effort multipliers, Table 9. Therefore, the multiplier formula explains the impact of each level if the effort estimation model formula uses a linear multiplier to capture the parameter impact.

Table 9. COCOMO II Personnel Parameters Effort Multipliers

Driver	Lowest	Nominal	Highest
Analyst Capability (ACAP)	1.42	1.00	0.71
Programmer Capability (PCAP)	1.34	1.00	0.76
Personnel Continuity (PCON)	1.29	1.00	0.81
Applications Experience (APEX)	1.22	1.00	0.81
Platform Experience (PLEX)	1.19	1.00	0.85
Language/Tool Experience (LTEX)	1.20	1.00	0.84

Generalization of Multipliers – Independence Test.

The COCOMO II published effort multipliers were replicated using the data collection process and multiplier formula. The effort multiplier formula used the nominal effort estimate as the baseline, indicating the parameters are not impacting the effort estimate, to calculate the multiplier values. The parameters are said to be independent if the change in the effort estimate can be explained by each parameter's impact

individually. The X_{NOM} value was changed to 120.60, highest skill level setting for the ACAP parameter, to test independence of the parameters.

The multiplier values were recalculated in Table 10 with the new baseline. The new effort multiplier values were the same as the original effort multipliers indicating linear multiplication is used in this model. The values for Analyst Capabilities do not appear to match the original values. However, mathematically it is correct taking into account that the baseline effort months, X_{NOM}, is set to trial 608, Analyst Capabilities' highest level. Calculating the new effort multipliers with the new baseline lowered the reference point. Dividing each of the Analyst Capabilities values by 0.71 would restore the original values. Therefore, independence of the parameters is demonstrated. This independence test can now be used for the other three models to calculate effort multipliers and determine if the values can be used to build cost estimate risk ranges.

Table 10. COCOMO II Effort Multiplier Independence Test

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Multiplier
Costar 122	1.42	1	1	1	1	1	241.20	2.00
Costar 365	1	1	1	1	1	1	169.90	1.41
Costar 527	0.71	1.34	1	1	1	1	161.60	1.34
Costar 581	0.71	1	1.29	1	1	1	155.60	1.29
Costar 599	0.71	1	1	1.22	1	1	147.10	1.22
Costar 605	0.71	1	1	1	1.19	1	143.50	1.19
Costar 607	0.71	1	1	1	1	1.2	144.70	1.20
Costar 608	0.71	1	1	1	1	1	120.60	1.00
Costar 609	0.71	1	1	1	1	0.84	101.30	0.84
Costar 611	0.71	1	1	1	0.85	1	102.50	0.85
Costar 617	0.71	1	1	0.81	1	1	97.70	0.81
Costar 635	0.71	1	0.81	1	1	1	97.70	0.81
Costar 689	0.71	0.76	1	1	1	1	91.70	0.76

Impact Range.

The impact each parameter will have on the effort estimate is graphically seen in Figure 19. The slope of the line from lowest to nominal is steeper than the slope from nominal to highest. This indicates that an improvement in skill level between the lowest and nominal rating will reduce effort more dramatically that further improves from nominal to highest. The rest of the skill level data points are necessary for a complete characterization.

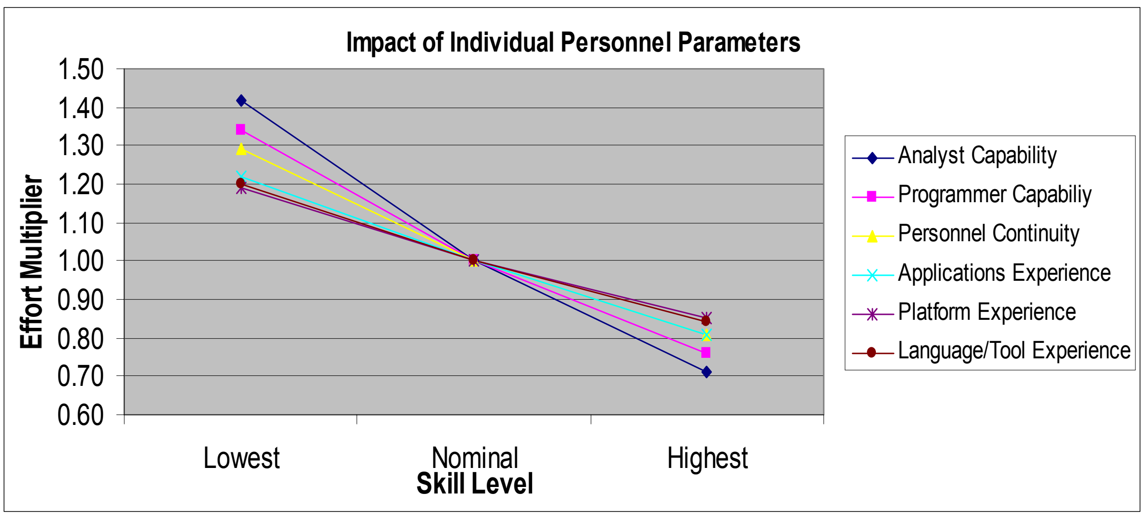


Figure 19. COCOMO II Personnel Effort Multipliers Spider Plot

The values of each parameter at the lowest and highest levels are used to calculate the individual productivity range and determine which parameter has the most impact on effort. The individual productivity range measures the overall impact of each parameter. This value is calculated by dividing the largest multiplier value by the smallest multiplier value. The productivity range for Analyst Capability is 2.00, 1.42 divided by 0.71. Analyst Capability impacts the effort estimate more than any of the other personnel parameters as seen in Figure 20.

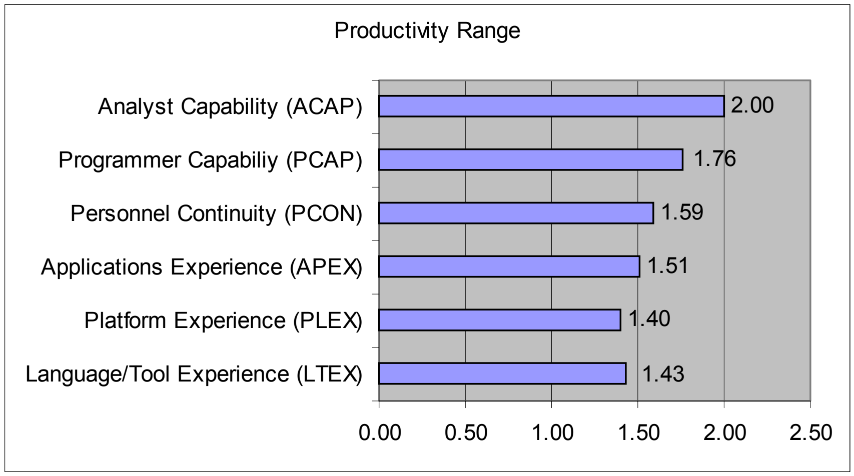


Figure 20. COCOMO II Personnel Parameters Productivity Range

The fact that Analyst Capabilities impacts the effort estimate the most makes sense from a software development stand point. Analysts determine the initial requirements and software design which typically takes more effort than coding. The programmers use the initial design and requirements to complete the coding process. Tremendous effort would be wasted if the initial design must be reaccomplished due to incorrect analysis.

Boehm calculates the individual productivity range for all the COCOMO II effort multipliers in the front cover of his book [23]. The book shows the Analyst Capability parameter has the second most impact on the effort estimate of the 17 parameters. The individual productivity range is the first level to evaluate effort impact. The next level is the group productivity range.

The group productivity range is the product of the individual productivity ranges. This definition is consistent with how Boehm's states that the personnel parameters have the most impact on the effort estimate since the personnel group productivity range is largest of the four cost driver groupings [23]. The productivity range for each cost driver

group is shown in Table 11. This indicates that more resources should be spent on determining the personnel and product parameter ratings since their impact can be much greater than platform and project parameters' impact.

Table 11. COCOMO II Post-Architecture Group Productivity Ranges

Cost Driver	Group Productivity Range
Product Parameters	10.40
Platform Parameters	3.56
Personnel Parameters	16.90
Project Parameters	3.27

The impact of the personnel parameters on effort can be seen in Figure 21. This graph shows the effort estimate for all 729 different trials used in the experiment verses the corresponding effort multiplier. The highest skill level combination resulted in an effort estimate that was 25 percent of the nominal estimate. The lowest skill level increased the effort estimate to 428 percent of the nominal estimate.

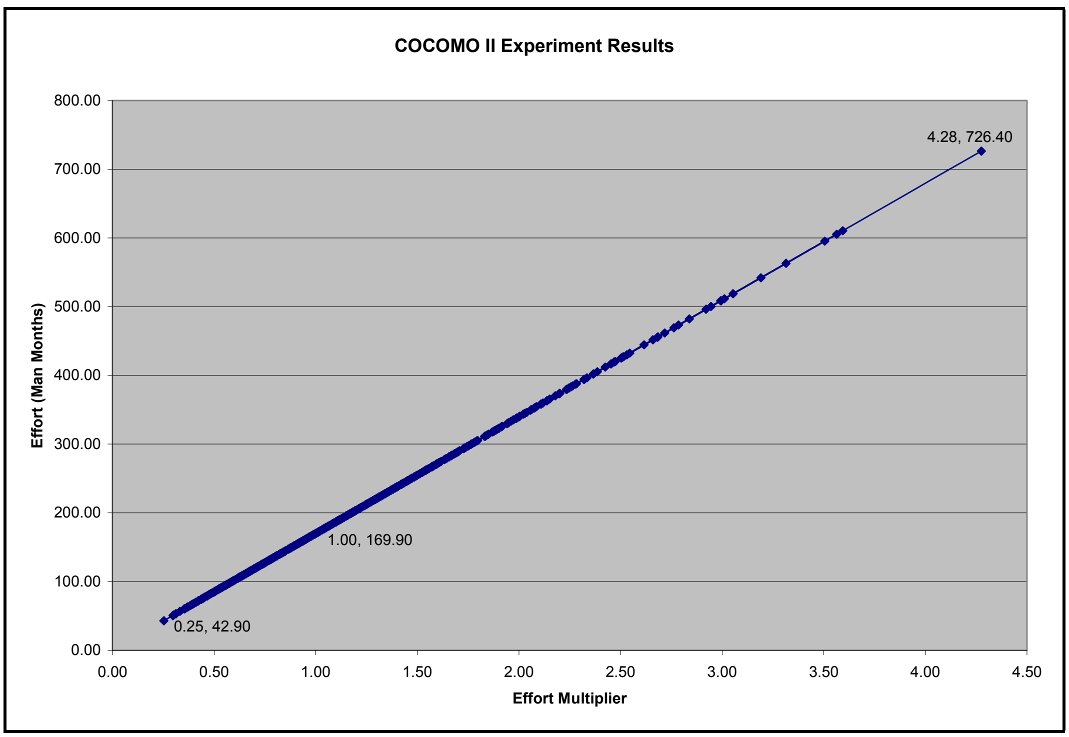


Figure 21. Overall COCOMO II Personnel Parameters Impact

The effort months were distributed from a low of 42.90 to a high of 726.40 person-months and corresponding effort multipliers from 0.25 to 4.28 respectively. Using Palisade Decision Tools' Best Fit 4.5 software, the best fit distribution for the effort multipliers was the Gamma distribution using the Chi-Square for Goodness-of-fit, Figure 22.

The graph shows that 90 percent of the effort multiplier combination values are between 0.45 and 2.26. 47 percent of the values are below the nominal value of 1.00. The 90 percent interval could be used to develop a risk range if the personnel parameters could not be determined. Notice that this distribution does not imply the likelihood of the personnel parameter being estimated at one value when they are in fact actually another. That data comes from estimates of completed projects which is not collected by the DoD.

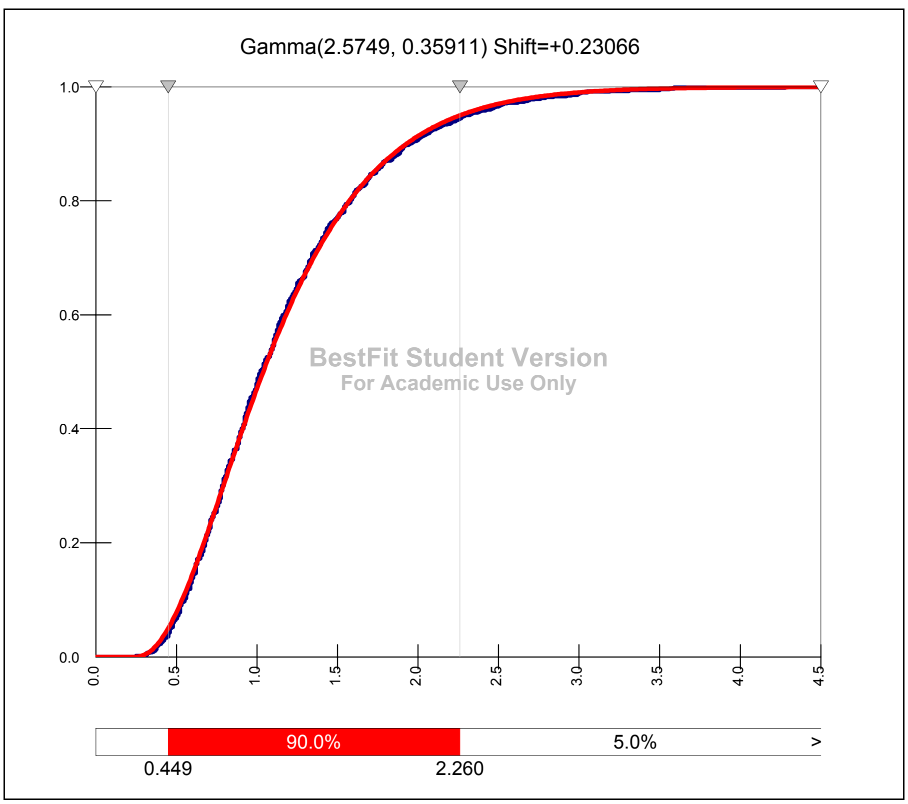


Figure 22. COCOMO II Personnel Effort Multiplier Distribution

Linear/Nonlinear Impact.

The personnel parameters appear to have an exponential effect on the effort estimate as seen in Figure 23. The effort estimate increases significantly as the skill level moves from a nominal rating to a low rating. The change from nominal to the highest skill level rating has a smaller slope indicating that the increase in skill level does not impact the effort required on a linear scale. Exponential impact is not conclusive from this graph given that the X axis is a qualitative scale instead of discrete data and intermediate points were not collected.

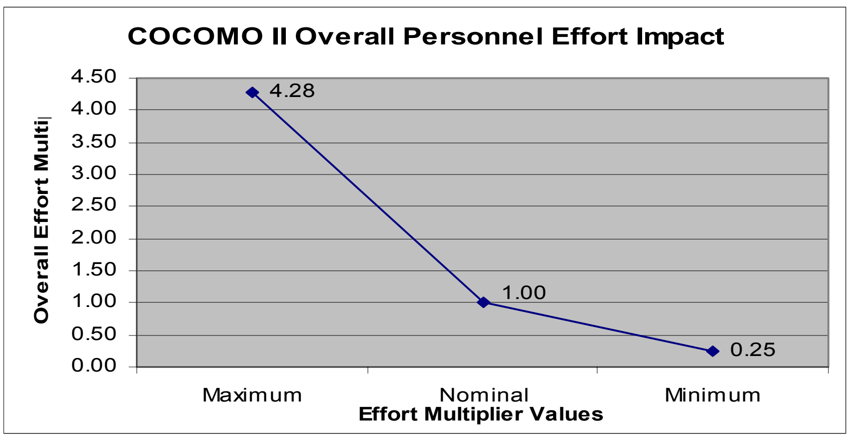


Figure 23. COCOMO II Calculated Personnel Effort Impact

These results are consistent with Boehm's results. Therefore, the analysis procedures can be applied to other models to understand how parameters other than size are impacting the effort estimate. Effort multipliers can be calculated for a model if it uses linear multiplication to account for the parameter influence. The values shown in Figure 21 and 23 were identical indicating linear multiplication in the model. Cost analysts can use the published information to develop risk-adjusted estimates as suggested by Boehm in the book [23].

SEER-SEM.

The effort multiplier values calculated for SEER-SEM were very similar to the effort multipliers in COCOMO II. The baseline effort estimate was 361.30 man-months. Personnel parameters with the most impact to effort are Analyst Capabilities and Programmer Capabilities. The personnel group productivity range was calculated to be 8.70. 90 percent of the effort multipliers fell between 0.60 and 2.45. Results support the effort multipliers being used as risk factors. The raw experiment data is located in Appendix 8.

Effort Multipliers.

Effort multipliers were calculated for each cost driver, Table 12. Analyst Capabilities will increase the nominal effort estimate by 140 percent when the development team's analysts have the lowest skill level. The effort estimate would decrease to 74 percent of the nominal estimate if the development team's programmer capabilities were the highest rating.

Table 12. SEER-SEM Calculated Effort Multipliers

Driver	Lowest	Nominal	Highest
Analyst Capabilities	1.40	1.00	0.74
Analyst's Application Experience	1.34	1.00	0.89
Programmer Capabilities	1.37	1.00	0.73
Programmer's Language Experience	1.22	1.00	0.99
Development System Experience	1.15	1.00	0.96
Target System Experience	1.08	1.00	0.98

Generalization of Multipliers – Independence Test.

The multiplier values were recalculated in Table 13 with the new baseline of 266.35 man-months. The new effort multiplier values were the same as the original effort multipliers indicating linear multiplication is used in this model.

Analyst Capabilities' values do not appear to match the orginal values. However, mathematically it is correct taking into account that the baseline effort months, X_{NOM}, is set to trial 608, Analyst Capabilities' highest level. Calculating the new effort multipliers with the new baseline lowered the reference point. Multiplying each of the Analyst Capabilities values by 0.74 would restore the original values. Therefore, independence of the parameters is demonstrated.

Table 13. SEER-SEM Effort Multiplier Independence Test

Driver	Lowest	Nominal	Highest
Analyst Capabilities	1.90	1.36	1.00
Analyst's Application Experience	1.34	1.36	0.89
Programmer Capabilities	1.37	1.36	0.73
Programmer's Language Experience	1.22	1.36	0.99
Development System Experience	1.15	1.36	0.96
Target System Experience	1.08	1.36	0.98

Impact Range.

The impact each parameter will have on the effort estimate is graphically seen in Figure 24. Analyst and Programmer Capabilities have the highest and lowest effort multiplier values. The change in the effort multiplier for these two parameters appears to be nearly constant as the skill level increases from the lowest level to the highest level. However, this may not be the case since this graph does not include the data for the rest

of the skill levels. Programmer's Language, Develop System, and Target System Experience appear to have minimal impact above the nominal skill level.

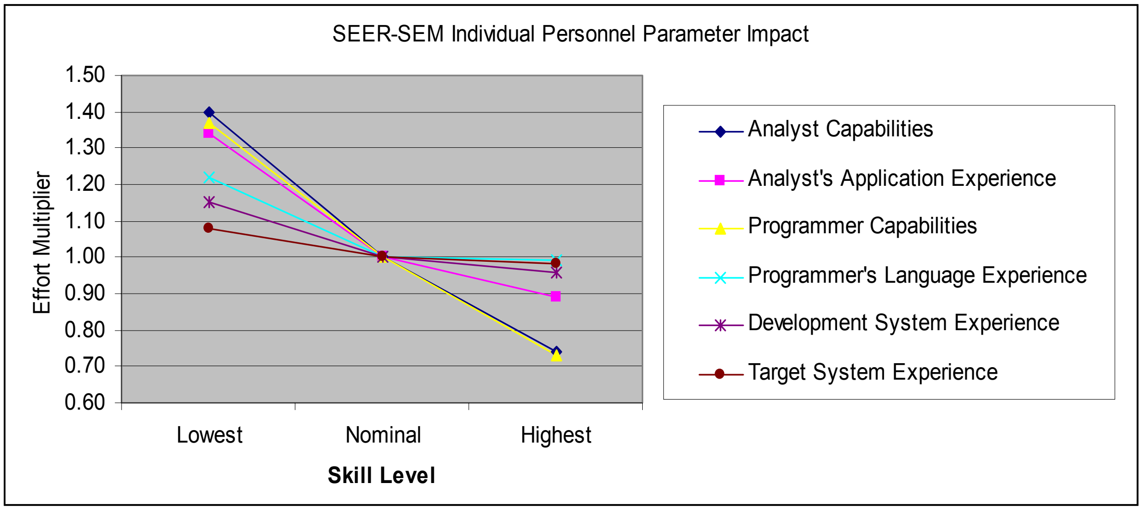


Figure 24. SEER-SEM Personnel Parameters Spider Plot

Calculating the productivity range, Figure 25, for each of the six parameters reveals the individual parameter impact. Analyst Capabilities and Programmer Capabilities have nearly equal impact. The Analyst Capabilities value is the same as the COCOMO II value. However, Programmer Capabilities range has 13 percent more impact than COCOMO's Programmer Capabilities parameter.

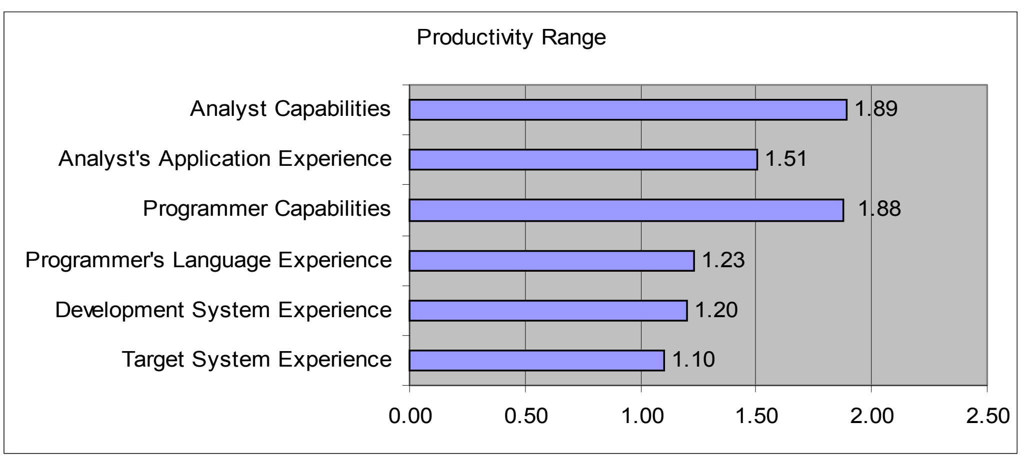


Figure 25. SEER-SEM Personnel Parameters Productivity Range

The impact of the personnel parameters on effort can be seen in Figure 26. This graph shows the effort estimate results for all 729 trials used in the experiment verses the corresponding effort multiplier. The highest skill level combination resulted in an effort estimate that was 44 percent of the nominal estimate. The lowest skill level combination increased the effort estimate to 387 percent of the nominal estimate. The group productivity range was calculated to be 8.70.

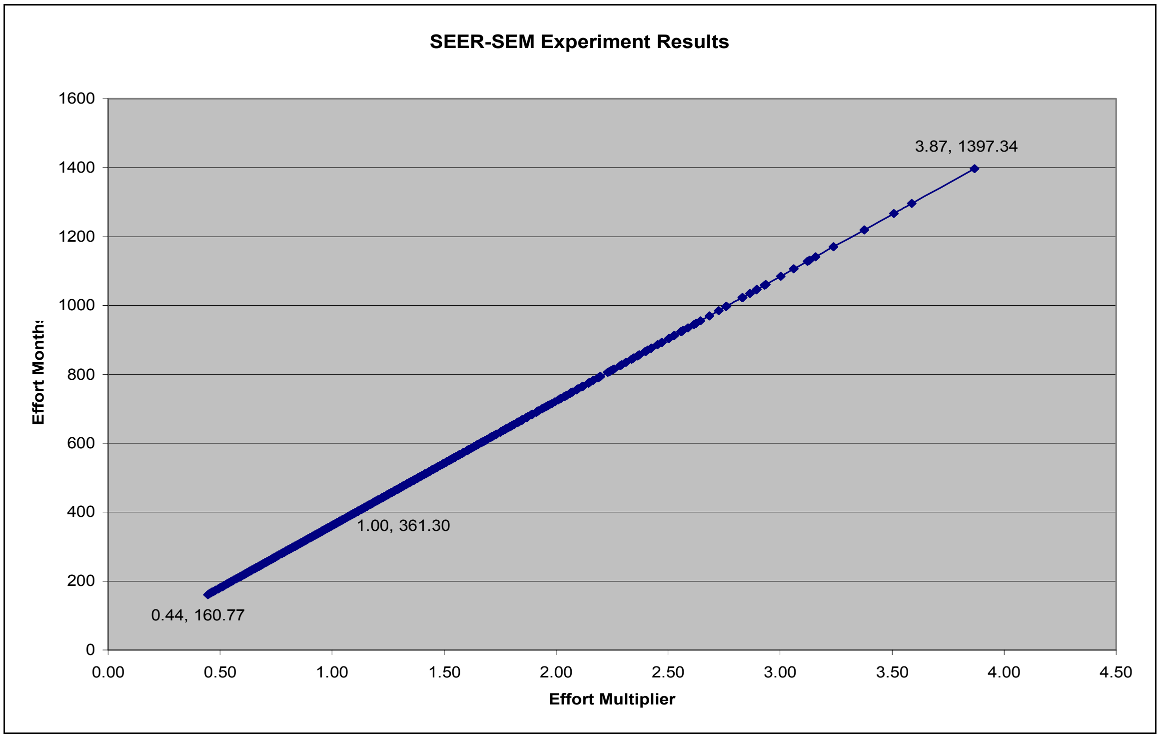


Figure 26. Overall SEER-SEM Personnel Parameters Impact

The effort estimates were distributed from a low of 160.77 to a high of 1,397.34 person-months and corresponding effort multipliers from 0.44 to 3.87 respectively. The best fit distribution for the effort multipliers was the Pearson5 distribution using the Chi-Square for Goodness-of-fit, Figure 27.

The cumulative distribution graph shows that 90 percent of the effort multiplier values are between 0.60 and 2. 45. This information could be used to develop an upward

risk adjusted estimate in the event that the personnel information was unknown or mischaracterized and all other cost driver information was known. The 90 percent interval was suggested assuming the worst and best skill level would not be realistically hired.

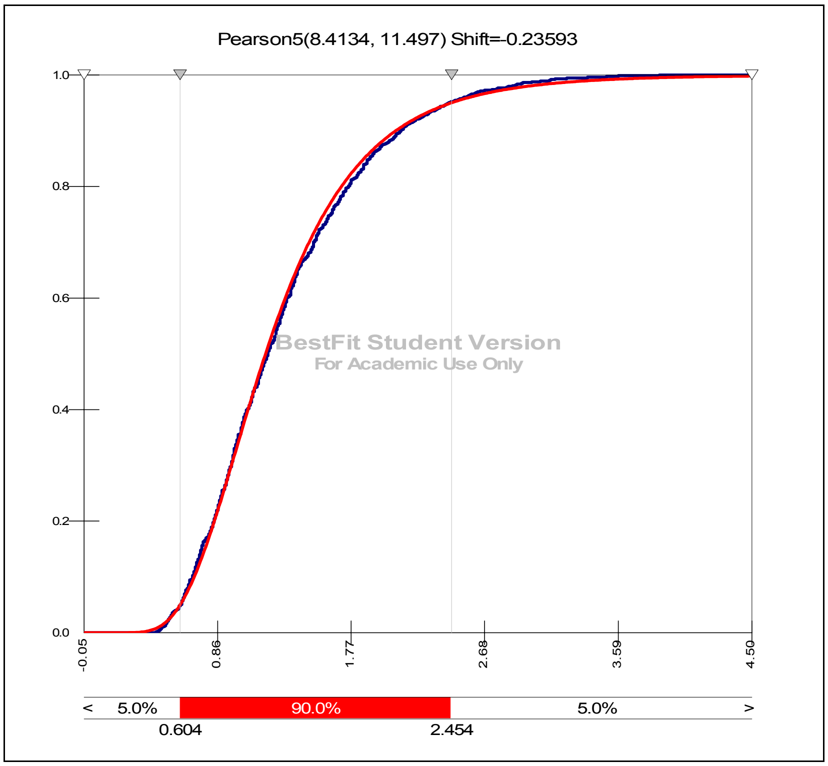


Figure 27. SEER-SEM Personnel Effort Multiplier Data Distribution

Linear/Nonlinear Impact.

The overall calculated impact of the personnel parameters, Figure 28, on the effort estimate matches the experiment results data in Figure 26. The largest change, 3.87, from the nominal effort estimate in the experiment results data equaled the product of each parameter's maximum effort multiplier values. The minimum effort multiplier values multiplied together resulted in the lowest effort estimate and smallest change from nominal. This is another indication that linear multiplication is performed within the

model algorithms. Thus, the effort multiplier values can be used as risk factors to adjust the SEER-SEM estimate if the personnel parameters are unknown.

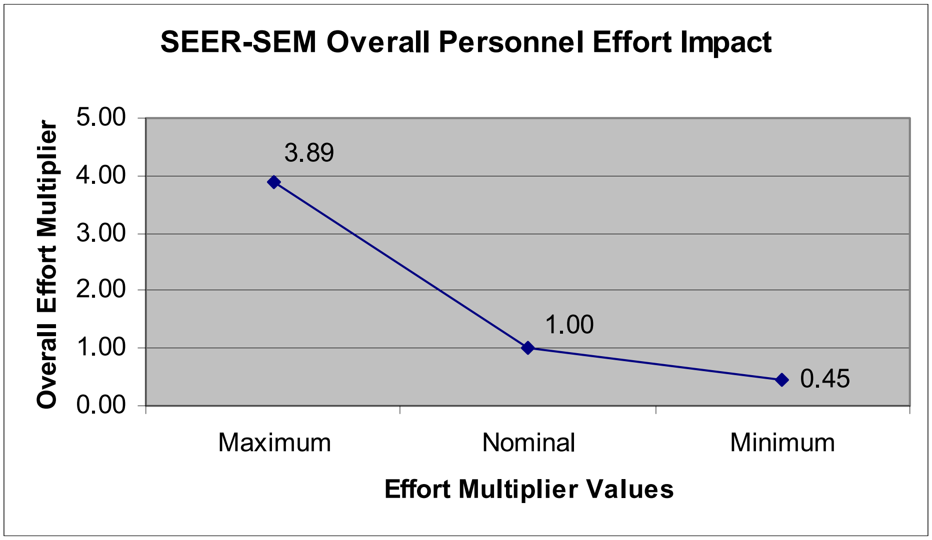


Figure 28. Overall SEER-SEM Calculated Personnel Effort Impact

SLIM.

The effort multiplier values calculated for SLIM were similar to the effort multipliers in COCOMO II. The baseline effort estimate is 254.73 man-months. The personnel parameters all have the same effort multipliers. However, the independence test was not satisfied. This indicates SLIM does not use linear multiplication in the algorithms to account for the impact of the cost drivers. The personnel group productivity range was calculated to be 34.09. 90 percent of the effort multipliers fell between 0.74 and 1.26. Results do not support using the calculated effort multipliers as risk factors unless only one multiplier is used at a time since the parameters are not independent. Raw experiment data is located in Appendix 9.

Effort Multipliers.

Effort multipliers were calculated for each cost driver, Table 14. The results were very different than those obtained for COCOMO II and SEER-SEM. All six parameters have the same values; although two parameters, Q3 and Q9, have the effort multipliers reversed. Q3 measures the staff turnover in the company. This measures the inverse of COCOMO II's Personnel Continuity. Thus, the reversal of the multipliers when compared to COCOMO.

Table 14. SLIM Calculated Effort Multipliers

Question	Lowest	Nominal	Highest
Q1 (Management and Leadership)	1.33	1.00	0.74
Q3 (Staff Turnover)	0.75	1.00	1.35
Q4 (Skilled Manpower)	1.33	1.00	0.74
Q5 (Functional Knowledge)	1.33	1.00	0.74
Q6 (Application Experience)	1.33	1.00	0.74
Q9 (Communication Complexity)	0.75	1.00	1.35

Generalization of Multipliers – Independence Test.

The multiplier values were recalculated in Table 15 with the new baseline of 188.08 man-months. The original effort multipliers were not reproduced. This indicates that the model does not use linear multiplication. Therefore, the original multipliers would only be relevant for the input scenario in this experiment. Further analysis would need to be conducted to characterize the personnel impact in the SLIM model beyond this scenario.

Table 15. SLIM Effort Multiplier Independence Test

Question	Lowest	Nominal	Highest
Q1 (Management and Leadership)	1.80	1.35	1.00
Q3 (Staff Turnover)	1.02	1.35	1.33
Q4 (Skilled Manpower)	1.26	1.35	1.00
Q5 (Functional Knowledge)	1.26	1.35	1.00
Q6 (Application Experience)	1.24	1.35	1.00
Q9 (Communication Complexity)	1.02	1.35	1.38

Impact Range.

The impact each parameter will have on the effort estimate is graphically seen in Figure 29. Questions one and four through six will decrease the required effort as the rating is increased from the lowest level to the highest level. Questions three and nine will increase the effort as the rating is increased from the lowest to the highest level.

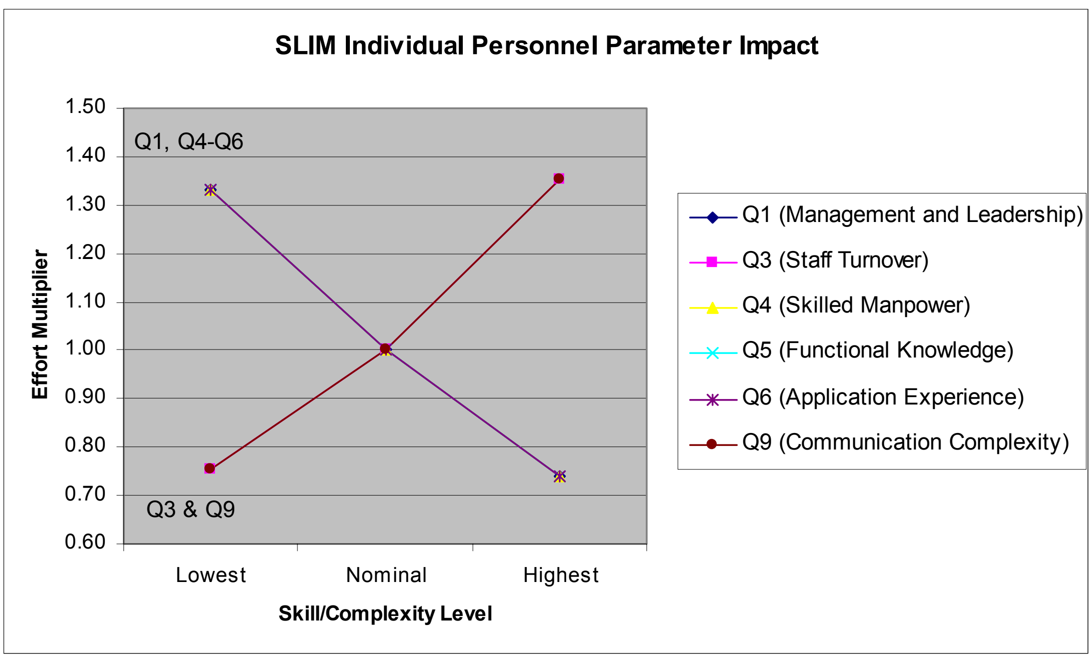


Figure 29. SLIM Personnel Parameters Spider Plot

Calculating the individual productivity range, Figure 30, shows that all six parameters have the same impact on the effort estimate. This is contradictory to

information in the SLIM-Estimate 5.0 User's Guide. "Not only do some questions carry more weight than others do; as your answers approach the opposite ends of the spectrum (0 or 10), they will have more impact on the PI [Productivity Index]. You will also find that as you answer more questions, each individual answer has less of an impact on the final PI" [25:104]. This indicates that the algorithm used to calculate the personnel impact is very complex.

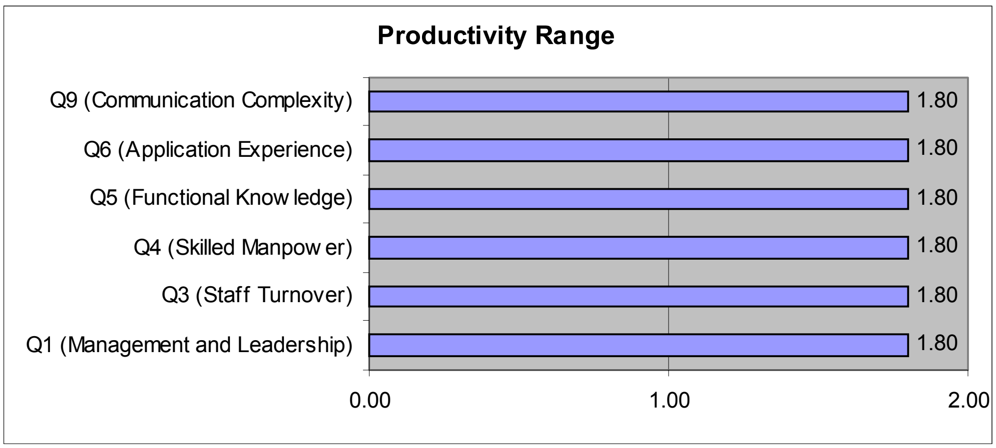


Figure 30. SLIM Personnel Parameters Productivity Range

The impact of the personnel parameters on effort can be seen in Figure 31. The group productivity range was calculated to be 34.09, indicating twice the impact of COCOMO II. The actual experiment results do not support the group productivity range. The highest skill level

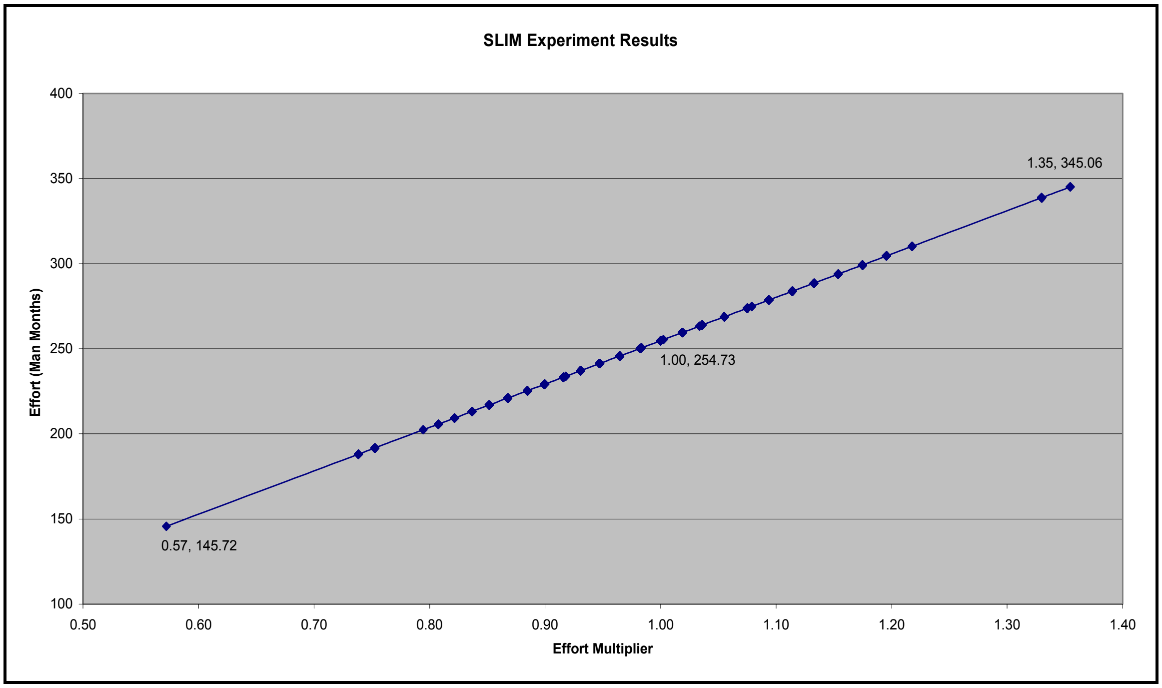


Figure 31. Overall SLIM Personnel Parameters Impact

resulted in an effort estimate that was 57 percent of the nominal estimate. The lowest skill level combination increased the effort estimate to 135 percent of the nominal estimate. The experiment data would calculate a 2.37 group productivity range. Further analysis is required to determine if this characterization of the personnel parameters is valid given that the impact of the individual parameters can change depending on the number of questions answered.

The effort months were distributed from a low of 145.72 to a high of 345.06 person-months and corresponding effort multipliers from 0.57 to 1.35 respectively. Using Palisade Decision Tools' Best Fit 4.5 software, the best fit distribution for the effort multipliers was the Normal distribution using the Chi-Square for Goodness-of-fit, Figure 32. The graph shows that 90 percent of the effort multiplier values are between 0.74 and 1.26.

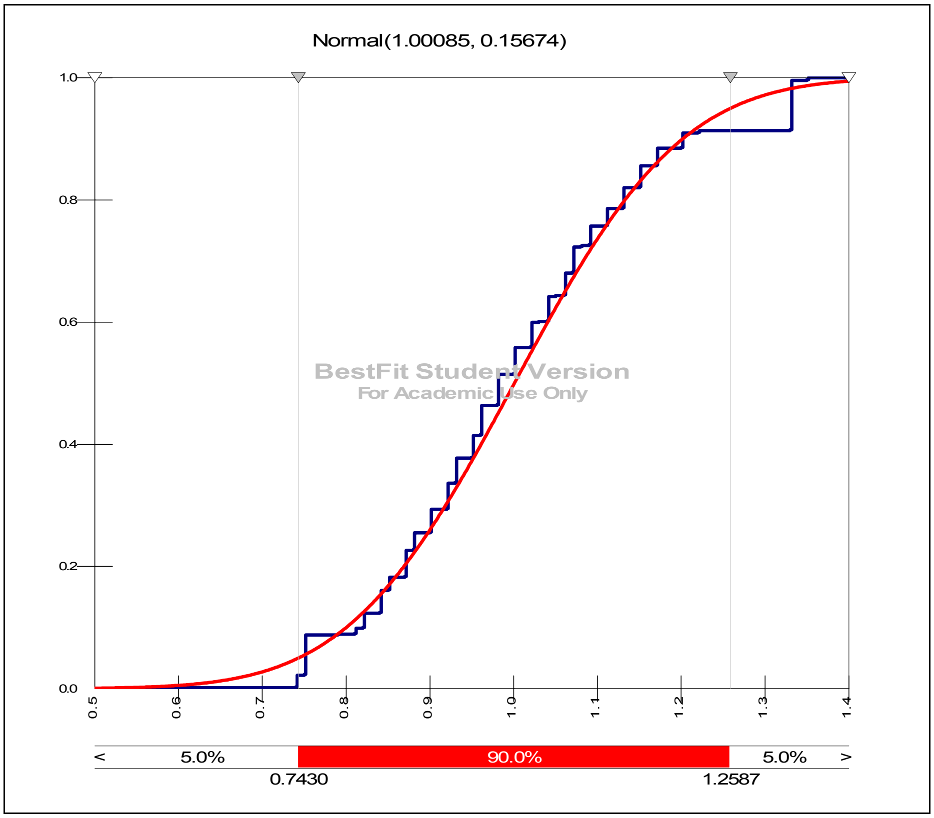


Figure 32. SLIM Personnel Effort Multipliers Data Distribution

Linear/Nonlinear Impact.

The overall calculated impact of the personnel parameters, Figure 33, does not match the experiment results in Figure 31. Linear/Nonlinear impact was not conclusive given the effort multipliers did not pass the independence test. Nonlinear impact was determined after contacting SLIM technical support personnel. These results indicate the calculated effort multipliers are not reliable to be used as risk factors.

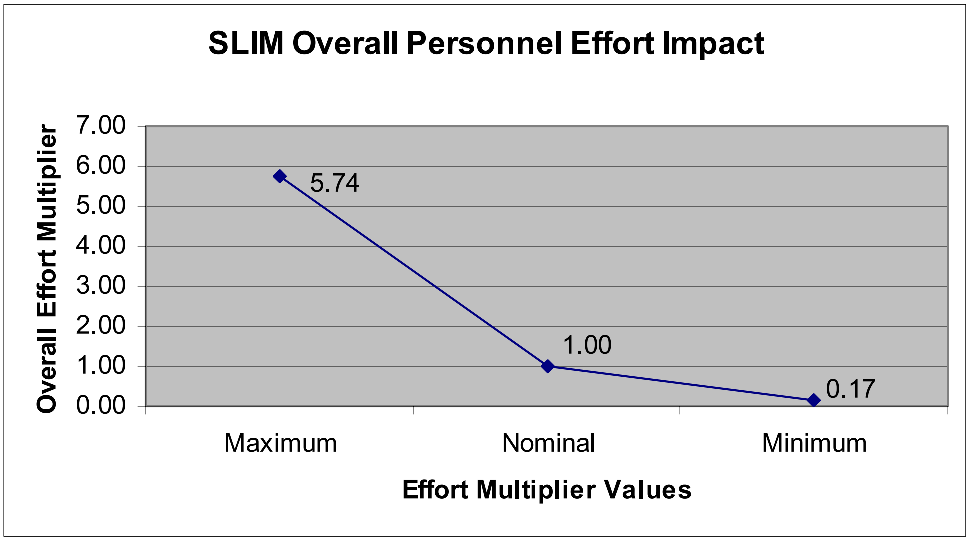


Figure 33. Overall Calculated SLIM Personnel Effort Impact

For example, if Communication Complexity (Q3) and Staff Turnover (Q9) parameters were set at the highest setting, the resultant effort multiplier should be 1.82; the product of 1.35 and 1.35 from Table 14. That combination should increase the nominal effort estimate from 254.73 to 463.61 man-months.

The calculated effort estimate can be confirmed by checking the actual experiment data. SLIM experiment run 447, page 140, corresponds to Q3 and Q9 set to the Hi setting and all other parameters set to nominal. The effort estimate result from SLIM is 345.06 man-months, not 463.61. The estimate returned by SLIM was the same effort estimate for Q3 set to Hi and all the other parameters set to nominal, run 446. This indicates a more complex algorithm than linear multiplication as indicated in the SLIM user's guide. The effort multipliers must be used very carefully as risk factors possibly in isolation from other multipliers given the interaction.

PRICE S.

The effort multiplier values calculated for PRICE S were very different from effort multipliers in COCOMO II. The baseline effort estimate was 1,717.20 man-months much higher than any of the other models. The personnel parameter with the most impact was calculated to be CPLX1. The personnel group productivity range was 99.67. 90 percent of the effort multipliers fell between 0.10 and 3.64. Results do not support using PROFAC effort multipliers as risk factors with CPLX1 and CPLXM. The raw experiment data is in Appendix 10.

Effort Multipliers.

Effort multipliers were calculated for each personnel parameter, Table 16. PROFAC increases the required effort when productivity is low. The required effort decreases as the productivity increases to the highest rating as seen in the decreasing effort multiplier values. Intuitively, this would be the reverse for CPLX1 and CPLXM since lower complexity would require less effort as seen in the effort multipliers.CPLX1 would increase the effort estimate by 319 percent when personnel complexity was at the highest setting.

Table 16. PRICE S Calculated Effort Multipliers

Driver	Lowest	Nominal	Highest
PROFAC	1.10	1.00	0.91
CPLX1	0.07	1.00	3.19
CPLXM	1.00	1.00	1.87

Generalization of Multipliers – Independence Test.

The multiplier values were recalculated in Table 17 with the new baseline of 1,896.25 man-months. PROFAC did not pass the test, but CPLX1 and CPLXM did pass. These results are supported by the PRICE S user's guide. PROFAC is used in the core effort estimate equation as an exponent. Therefore, PROFAC's impact will not be linear. The model uses a linear

Table 17. PRICE S Effort Multiplier Independence Test

Driver	Lowest	Nominal	Highest
PROFAC	0.83	0.91	1.00
CPLX1	0.07	0.91	3.17
CPLXM	1.00	0.91	1.87

equation to capture the affects of CPLX1 and CPLXM. Figure 34 and 35 were constructed using the actual formula. The experimentally calculated effort multipliers are slightly different than the actual multipliers due to the formula construction.

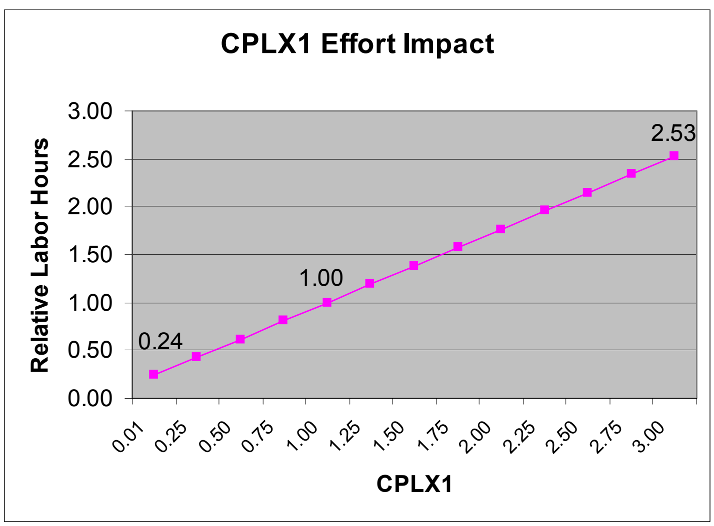


Figure 34. PRICE S CPLX1 Actual Impact [26:185]

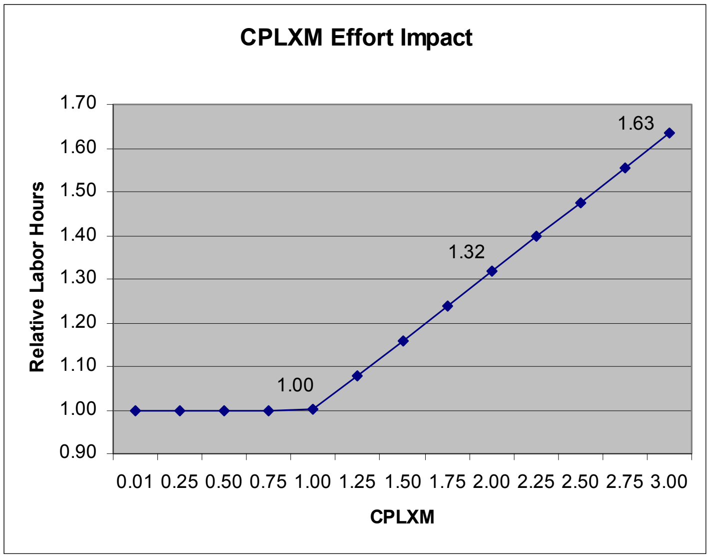


Figure 35. PRICE S CPLXM Actual Effort Impact [26:188]

Impact Range.

Calculating the individual productivity range, Figure 36, for each of the parameters reveals that CPLX1 has significantly more impact than the other two parameters. The fact that CPLX1 has more impact than CPLXM is supported using Figure 34 and 35. Figure 37 shows that as complexity increases effort increases, but as productivity increases effort decreases. Figure 37 shows PROFAC as actually a flat line. These plots for PROFAC are deceptive as to the actual impact PROFAC has on effort.

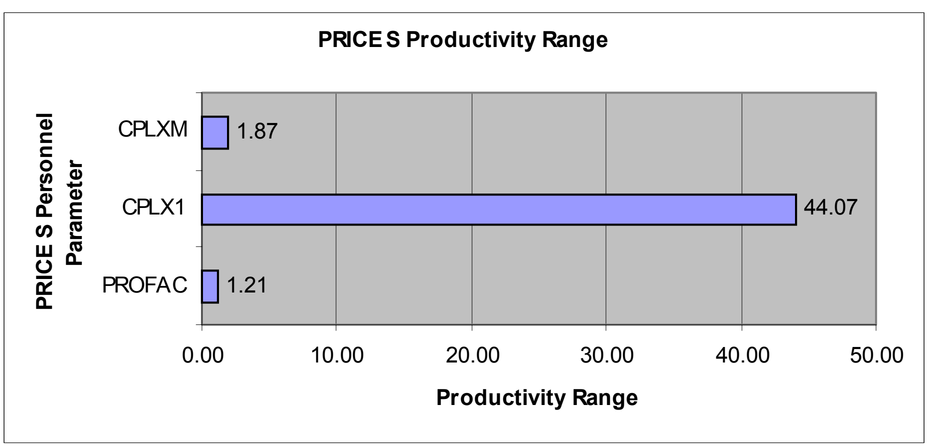


Figure 36. PRICE S Productivity Range

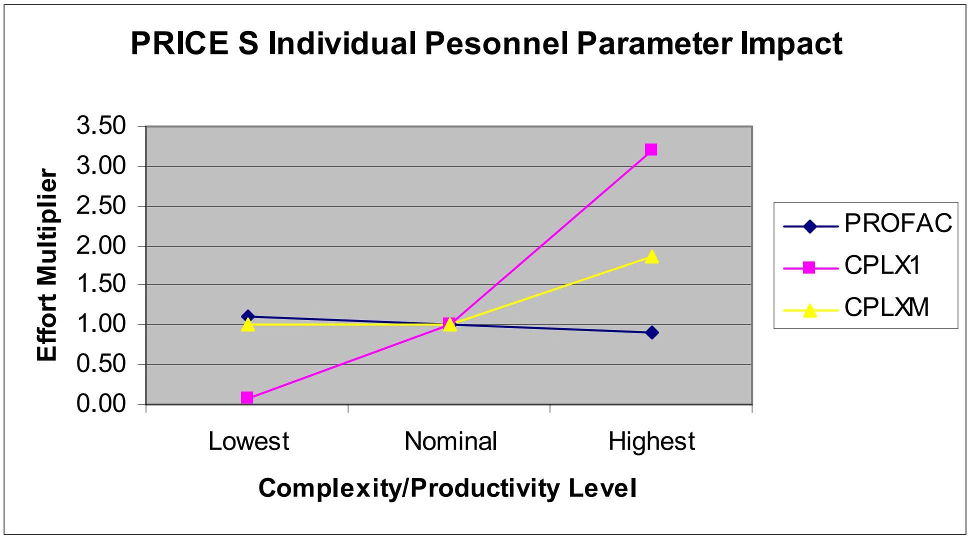


Figure 37. PRICE S Personnel Parameters Spider Plot

The reason is that PRICE S developed the PROFAC parameter to be used when historical productivity information about the development company was not known. The PROFAC parameter is a productivity scale based on historical data stratified by the type of platform.

PROFAC is broken up into five different platform areas; 0.8, 1.2, 1.4, 1.8, and > 1.8 as seen in Figure 38. The platform value is chosen first, then the lower and upper bounds of the PROFAC are known. This is the reason it appears PROFAC has very little impact when it actually is very significant. The actual impact that PROFAC has on the effort estimate has a negative exponential effect as seen in Figure 38. The effort decreases as the productivity increases.

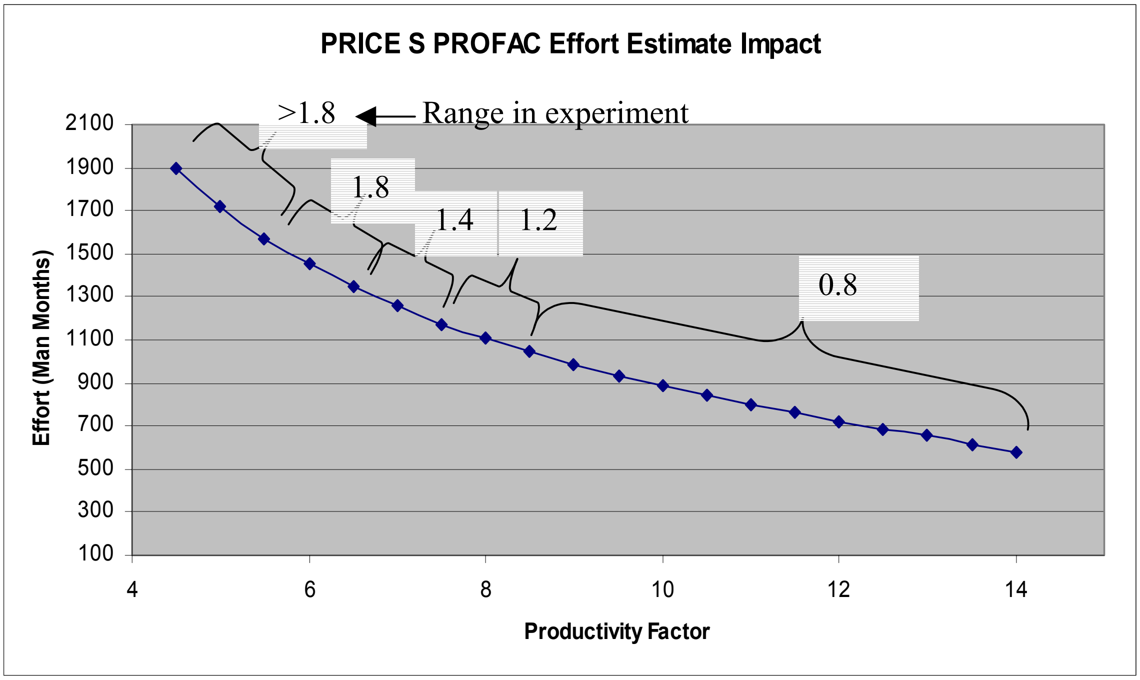


Figure 38. PRICE S PROFAC Effort Estimate Impact

The impact of the personnel parameters on effort can be seen in Figure 39. The maximum effort estimate was 350 percent greater than the nominal effort estimate. The minimum effort estimate was six percent of the nominal estimate. The group productivity range was calculated to be 99.67.

PRICE S experiment data included some effort estimates of zero. The model would not calculate a value when CPLX1 was set at a value of three and CPLXM was set at a value of two or three. PRICE S technical support personnel indicated this occurred due to the schedule estimate exceeding 20 years for development.

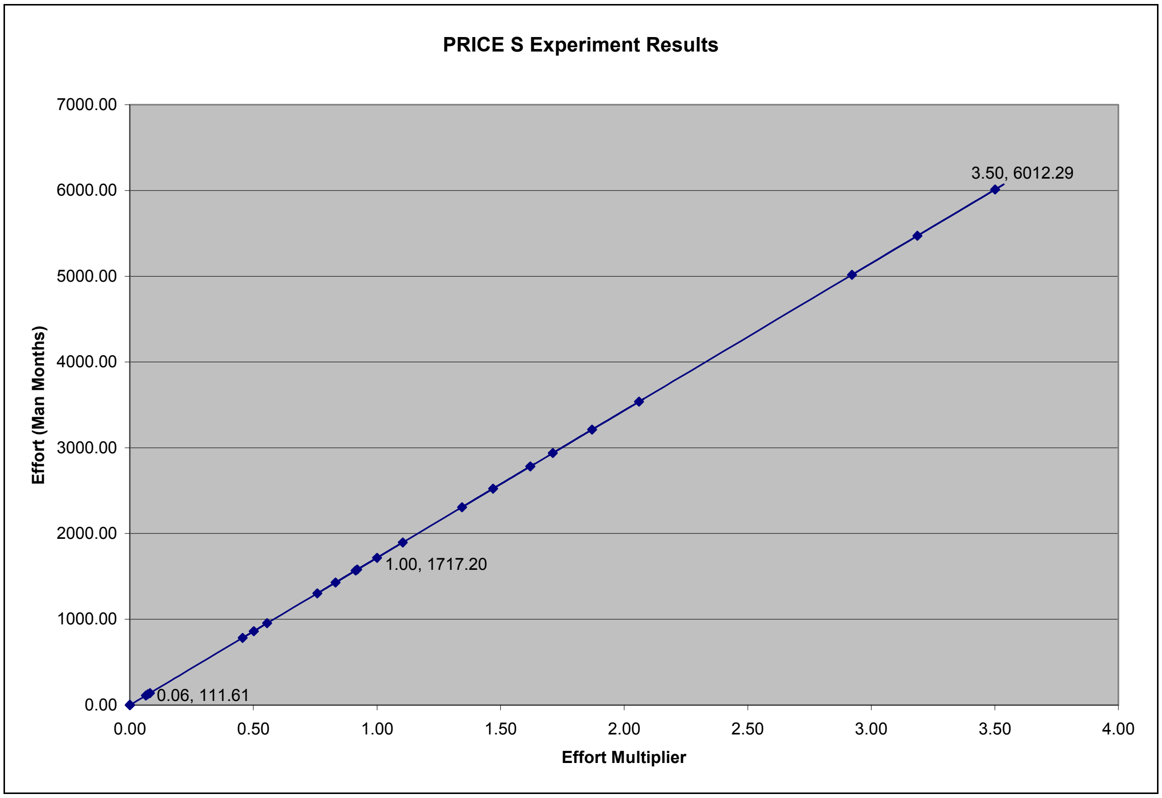


Figure 39. PRICE S Overall Personnel Effort Impact Results

The effort months were distributed from a low of 111.61 to a high of 6,012.29 person-months and corresponding effort multipliers from 0.06 to 3.50 respectively. The best fit distribution for the effort multipliers was the LogLogistic distribution using the Chi-Square for Goodness-of-fit, Figure 40. The graph shows that 90 percent of the effort multiplier combination values are between 0.10 and 3.64.

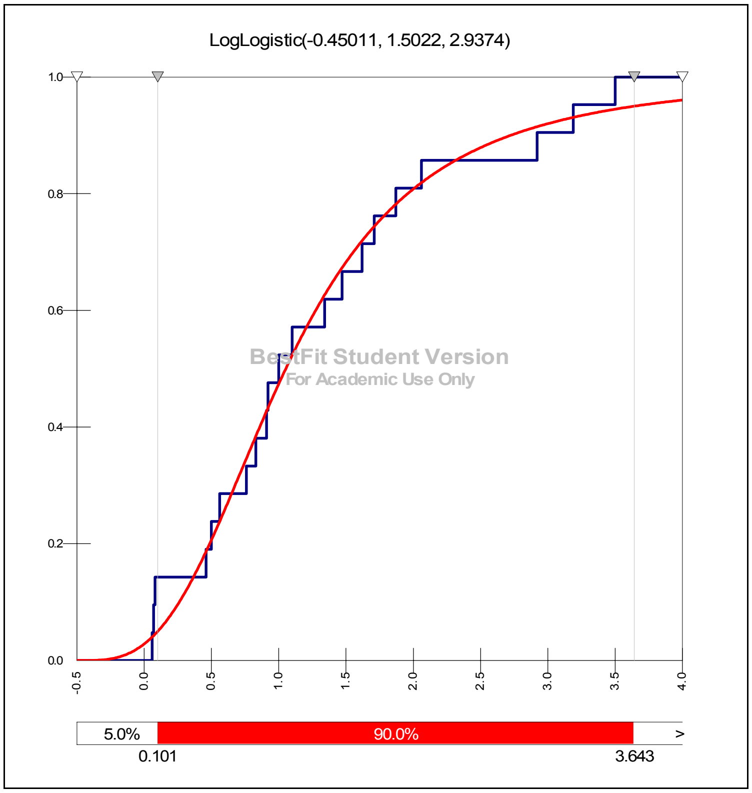


Figure 40. PRICE S Personnel Effort Multiplier Distribution

Linear/Nonlinear Impact.

The overall impact of the personnel parameters, Figure 41, on the effort estimate is just the reverse of the other models since the reverse parameter is being utilized to calculate the

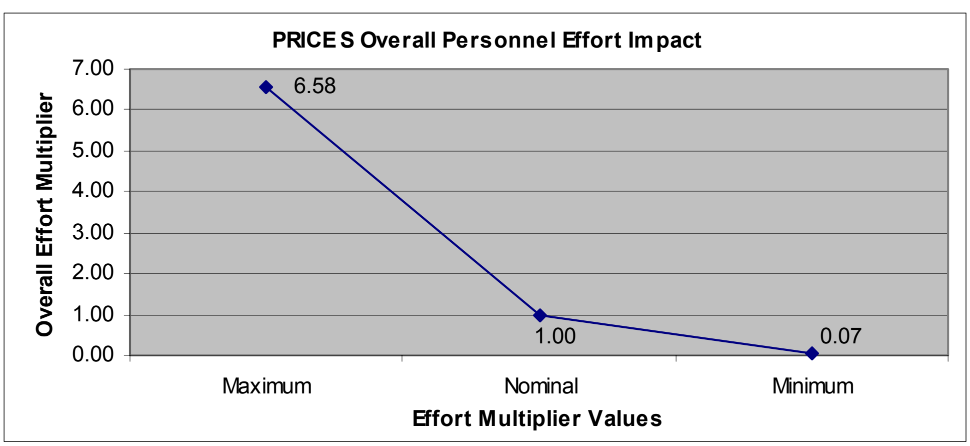


Figure 41. Overall PRICE S Personnel Effort Impact

impact on effort. The line has a positive slope. This means as the complexity level increases so does the effort. Overall PROFAC impact is not apparent since only a small portion of the PROFAC scale was utilized in this experiment scenario. The overall impact appears to be nonlinear since the slope of the line changes at the nominal level.

Model Comparisons

The objective of this study was to determine the relative change of a cost estimate from the baseline estimate, X_{NOM}, as personnel parameter input values were altered from the lowest rating to the highest rating and all other parameters were held constant. The individual model results explain how each model's personnel parameters impact the effort estimate. The results can also be compared to see if the models appear to be estimating the same development scenario. Figure 42 is a graph of the estimated effort verses the calculated effort multiplier that shows the relative change

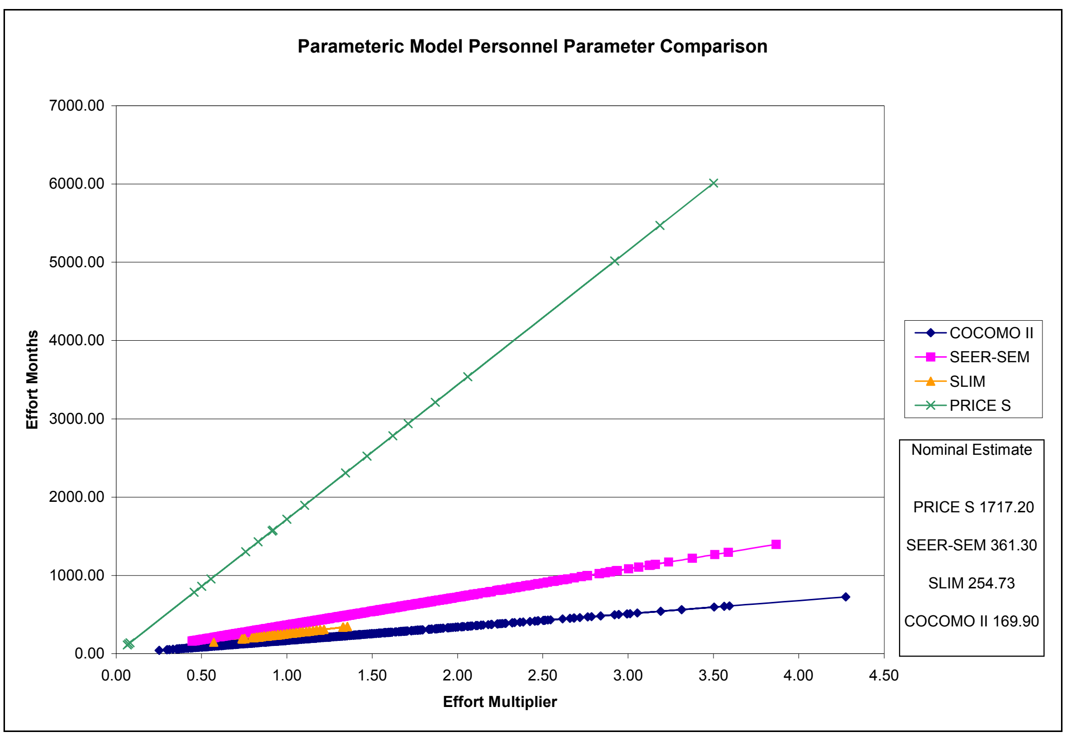


Figure 42. Parametric Model Personnel Comparison

The graph shows that COCOMO II, SEER-SEM, and SLIM are estimating very similar nominal effort results. The nominal values calculated with the initial inputs and all other parameters set to the nominal setting are noted on the graph. PRICE S appears to have an initial input that has elevated the nominal effort estimate substantially above the other three models. This was evaluated with PRICE S personnel. No conclusive reason was be given that explained the difference in the nominal estimates.

The SLIM results had an anomaly as well. The effort estimates were estimated in a very tight pattern when compared to the other models. This would lead one to believe the personnel parameters had little impact on the effort estimate, yet the group productivity range was twice that of COCOMO II. The explanation given for the tight pattern results when Quantitative Software Management support personnel were contacted was that the personnel parameters in the productivity index are impacted by the size and the initial productivity index value.

Overall Personnel Parameter Impact Comparison

The secondary objective was to use the results of the experiment to develop risk factors that would enable analysts to develop cost estimate ranges based on the impact of the subject parameter values. The model's overall personnel impact graphs would provide the cost analyst the capability to develop a risk adjusted estimate for each of the models. Figure 43 shows the maximum and minimum risk range factors. The values for SLIM and PRICE S are not valid.

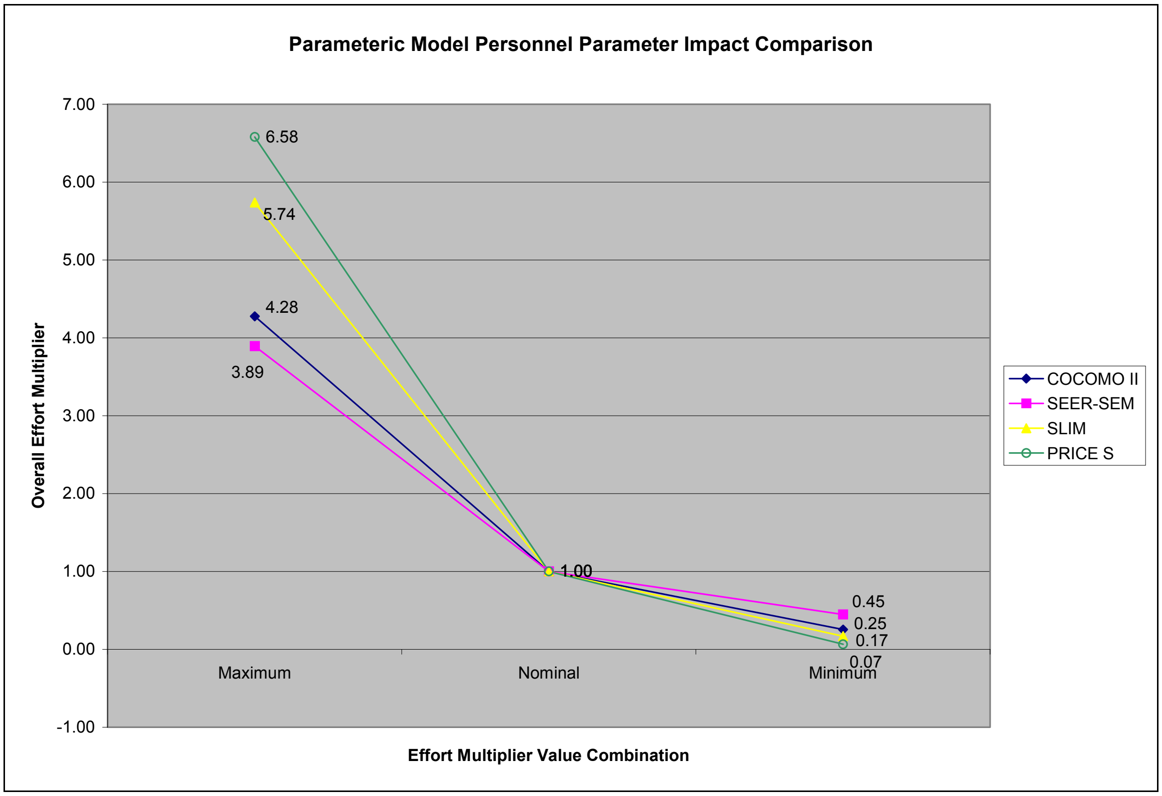


Figure 43. Parametric Model Personnel Parameter Impact Comparison

V. Conclusion

Overview

DoD has come to depend on software to improve the capabilities of its weapon systems. Software performs many tasks formerly executed by a man or woman. Weapon system capabilities are improved by developing software programs that enhance the weapon's ability to perform its intended mission. Increased spending on software has brought to light the need to manage software costs more closely to ensure resources are available in the budget to pay for approved programs.

In support of those programs, software cost estimation has evolved from early back-of-the envelope calculations to a rather complicated process, which has proven troublesome for accurate cost estimates. Cost estimators use a number of different methods to construct a software development cost estimate to include commercial parametric models, analogy, expert opinion, and bottom-up constructive estimates. Estimates could even be a combination of the methods.

In practice, DoD cost analysts most often use the parametric model method. Parametric models are fast, require little information to generate an estimate, and are just as accurate as other methods given the model has been calibrated and validated. The drawback to most parametric models is that the equations are not published limiting the cost analysts ability to understand exactly how the model is calculating the estimate. Many input parameters are based on a qualitative scale. The qualitative scale leaves room for subjective guessing. The risk of the analyst mischaracterizing the development environment could jeopardize a program. The program might not be approved if the estimate is too high or cancelled in the event costs are under estimated. This research is

intended to improve the Air Force ability to estimate software development projects by characterizing to relative importance of personnel parameters. Thus, estimators can gauge their estimation uncertainty based on their uncertainty about individual personnel parameters.

This research was conducted using four parametric models widely used in DoD; COCOMO II, SEER-SEM, SLIM, and PRICE S. Personnel parameters were chosen as the parameter group to study because literature suggests that personnel abilities impact the effort more than any factor other than size. The number of personnel inputs to analyze was reduced down to six since the analysis would include the lowest, nominal, and highest rating level.

Effort month data was collected from each of the parametric models COCOMO II, SEER-SEM, SLIM, and PRICE S. The data was analyzed to determine effort multipliers, independence of parameters, impact range, and linear/nonlinear impact. COCOMO II data was analyzed first to determine if the methodology could recreate the COCOMO II published personnel parameters' effort multipliers. The process was then repeated for each of the other three model's results.

Results

The objective of this study was to determine the relative change of a cost estimate from the baseline estimate as personnel parameter input values were altered from the lowest rating to the highest rating and all other parameters were held constant. This objective was accomplished. Additionally, the methodology for evaluating the parameter impact was validated.

The secondary objective was to use the results of the experiment to develop risk factors that will enable analysts to develop cost estimate ranges based on the uncertainty and impact of the subject parameter values. Risk factors were calculated for each subject parameter in each model. These risk factors can be applied under most scenarios with limitations. Risk ranges can be set for parameters in COCOMO II, SEER-SEM, SLIM, and PRICE S.

COCOMO II and SEER-SEM personnel effort multipliers can be used as risk factors without restriction. SLIM parameters were determined to not be independent. Thus, the risk factors calculated for SLIM cannot be used to determine effort estimates. PROFAC, one of the parameters in PRICE S, was determined to have a nonlinear impact on effort possibly skewing the overall impact values. For that reason and because PRICE S does use linear multiplication to apply the impact of CPLX1 and CPLXM, the calculated risk factors for CPLX1 and CPLXM are relevant when PROFAC is set at 5. Thus, PRICE S effort multipliers are only valid in this limited research scenario.

COCOMO II has six personnel parameters. Effort multipliers were calculated for all six parameters at the lowest and highest setting. The experimentally calculated effort multipliers matched the values published by Boehm. The baseline effort estimate used to calculate the COCOMO II effort multipliers was 169.90 man-months. The personnel parameters with the most impact to effort are Analyst Capability and Programmer Capability. The personnel group productivity range was 16.90. The effort multipliers fell between 0.25 and 4.28.

The effort multipliers can be used to develop the risk adjusted estimate for uncertainty in the personnel parameters. The risk can be applied to individual parameters

or the personnel parameters as a group. For example, if the cost analyst is uncertain about the Analyst Capabilities skill rating, the lowest skill level would change the current COCOMO II estimate by 142 percent. If the cost analyst felt the development company had above average Analyst Capabilities, the best skill level would reduce the estimate 29 percent since the effort multiplier is 0.71.

The other scenario is that the cost analyst has no information on the development company's individual personnel skills. The only piece of information given is that the company is above average in personnel skills. The best skill level would be when all the personnel parameters are rated very high. This combination of effort multiplier values produces the lowest personnel group multiplier 0.25. Multiplying 0.25 by the current estimate, 169.90 for example yields 42.48. These manaual calculations can be verified with the actual model data. The experiment run for the multiplier 0.25 is 729, page 118. The model estimate was 42.90. The difference is in rounding the group multiplier value instead of using the product of the individual parameter effort multiplier values.

SEER-SEM has seven personnel parameters. One parameter, Practices and Methods Experience, was removed since it did not impact the development stage effort estimate. The effort multiplier values calculated for SEER-SEM were very similar to the effort multipliers in COCOMO II. The baseline effort estimate was 361.30 man-months. Just over double COCOMO II's nominal estimate. The personnel parameters with the most impact to effort are Analyst Capabilities and Programmer Capabilities. The personnel group productivity range was 8.70. This means the variance of SEER-SEM effort multipliers is smaller than COCOMO II. The effort multipliers fell between 0.45 and 3.89.

Ensuring the risk factors work for SEER-SEM is important given that the values are not published by Galorath. The validity of the risk factors can be proven using the calculated effort multipliers for Analyst Capabilities and Programmer Capabilities at the lowest skill rating and verifying the results with actual SEER-SEM model data. However, any of the six parameters used in the experiment could be included.

The Analyst Capabilities and Programmer Capabilities' values are 1.40 and 1.37 respectively. Multiplying the values together produces 1.92. This value would be the upper risk bound on the estimate should the actual skill level not be known for Analyst Capabiltites and Programmer Capabilities. Nominal effort estimate of 361.30 multiplied by the risk factor of 1.92 results in an upper bound effort estimate of 693.70. This new estimate can be checked in Appendix 8 for the experiment run where Analyst Capabilities and Programmer Capabilities are rated low and the other parameters are nominal. The run number is 95 located on page 115. The values are slightly different due to rounding.

Developing a group risk factor works in a similar fashion. The upper bound risk factor would be calculated by the product of all the low rating effort multiplier values. The value would be 3.89. Multiplying 3.89 by 361.30 equals 1,405.46. Looking through the experiment data for the run with all parameters set to the lowest rating, run 1 page 113, the value is valid.

SLIM uses nine personnel parameters to calculate a productivity index. Six of the parameters were used in this experiment. The baseline effort estimate was 254.73 man-months. All the personnel parameters have the same effort multipliers indicating equal importance. The effort multipliers fell between 0.17 and 5.74. However, the independence test was not satisfied. This indicates SLIM does not use linear

multiplication in the algorithms to account for the impact of the cost drivers. Non-linearity and parameter interaction was confirmed by SLIM technical support. Therefore, the second objective was not satisfied for SLIM.

For example, if Communication Complexity (Q3) and Staff Turnover (Q9) parameters were set at the highest setting, the resultant effort multiplier should be 1.82; the product of 1.35 and 1.35 from Table 14. That combination should increase the nominal effort estimate from 254.73 to 463.61 man-months.

The calculated effort estimate can be confirmed by checking the actual experiment data. SLIM experiment run 447, page 140, corresponds to Q3 and Q9 set to the Hi setting and all other parameters set to nominal. The effort estimate result from SLIM is 345.06 man-months, not 463.61. The estimate returned by SLIM was the same effort estimate for Q3 set to Hi and all the other parameters set to nominal, run 446. This indicates a more complex algorithm than linear multiplication as indicated in the SLIM user's guide rendering the effort multipliers ineffective as risk factors.

PRICE S uses three personnel parameters. Therefore, only 27 different combinations were analyzed. The baseline effort estimate was 1,717.20 man-months. The personnel parameters with the most impact to effort appeared to be CPLX1. This conclusion was incorrect because the range of values used for PROFAC was limited by the software development scenario. PROFAC was determined to be a nonlinear parameter, while CPLX1 and CPLXM were linear. Therefore, the effort multipliers for PROFAC cannot be used to calculate risk ranges. Effort multipliers for CPLX1 and CPLXM can be used to develop risk ranges. The limitation being that this set of effort multipliers can only be used when the estimate uses PROFAC set to a value of 5. The

personnel group productivity range was 99.6. The effort multipliers fell between 0.07 and 6.58.

These results indicate that parameters other than size can have a significant impact on the cost estimate. For example, using the SEER-SEM impact ranges, 3.89 to 0.45, and the research scenario, the impact to cost can be shown. The nominal effort estimate was 361.30 man-months, costing $7,365,100 at $20,385 per man-month. The upper bound on the cost estimate could be $28,650,241. The lower bound could be $3,314,295. Thus, the risk of minor to major changes in personnel characterizing can have a significant impact on overall assessment of program cost.

The cost analyst's interpretation and qualitative/quantitative characterization of non-size parameters does or can have a dramatic impact on the estimated effort translating directly to cost. It is imperative for a cost analyst to gain an appreciation of, and account for, the potential risk of mis-estimating these parameters!

Future Research

This thesis effort developed a methodology for calculating linear effort multipliers given the model employs linear multiplication. The personnel parameter grouping was the area analyzed. Future research should explore other parameter groups to develop effort multipliers for each parameter in the model. Combining the data would generate an index that could be used to quickly develop risk adjusted estimates. Alternatively, the non-linear relationships should be explored to better characterize the risk ranges and possibly fully reverse engineer the models.

Risk adjusted estimates usually mean that an additional cost is anticipated given a probability of the risk event occurring. The calculated effort multipliers have an assumed uniform distribution. This is not the case in reality. The risk adjusted estimate could be further improved if probability data was determined for each qualitative level of the personnel parameters from completed projects.

Appendix 1 COSTAR VBA code

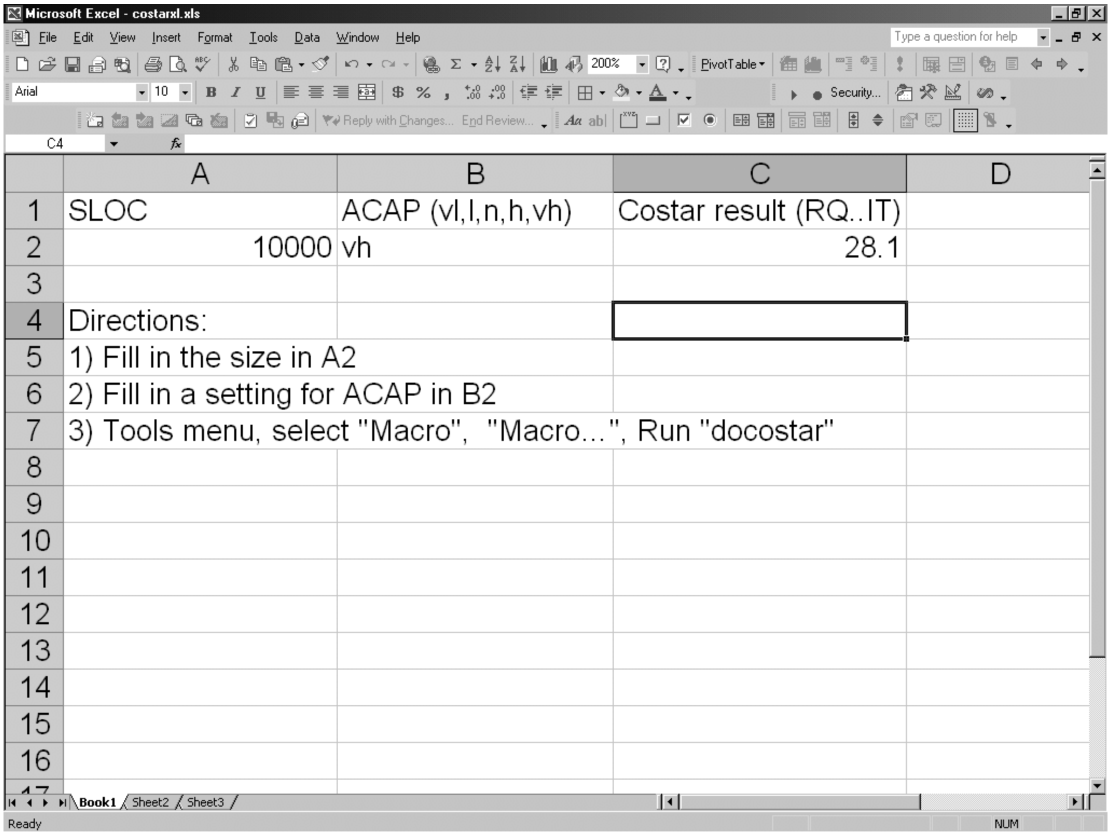


Figure 44. COSTAR Excel file

```
Sub docostar()
'
'  Proof of concept.
'      1)  Use values from spreadsheet to create a file of Costar commands
'      2)  Execute Costar, writing an ASCII version of a report
'      3)  Extract results from the report, put them into spreadsheet
'
Dim exe
Dim tempdir
Dim found
Dim i As Integer
Dim mystring
Dim answer
'
'  Find TEMP directory
'
tempdir = Environ("TEMP")

If tempdir = "" Then tempdir = "c:"
```

```
If Right(tempdir, 1) <> "\" Then tempdir = tempdir + "\"
'
'   Find Costar executable
'
exe = "\Program Files\Softstar\Costar 6\costar.exe"
found = Dir(exe)

If found <> "costar.exe" Then
   exe = "\Program Files\Softstar\Costar 6.0\costar.exe"
   found = Dir(exe)
End If

If found <> "costar.exe" Then
   exe = "\Program Files\Softstar\Costar 6 Demo\costar.exe"
   found = Dir(exe)
End If

If found <> "costar.exe" Then exe = "c:\costar.exe"
'
'   Write file of Costar commands
'
Open tempdir + "in.cmd" For Output As #1
Print #1, "ACAP "; Worksheets(1).Range("B2").Value
Print #1, "dsi "; Worksheets(1).Range("A2").Value
Print #1, "print detail "; tempdir + "costar.out"
Print #1, "save "; tempdir + "temp.cst"
Print #1, "quit"
Close #1
'
'   Execute Costar
'
RetVal = Shell(exe + " " + tempdir + "in.cmd", vbNormalFocus)
'
'   Read Costar results
'
Open tempdir + "costar.out" For Input As #1

For i = 1 To 17
   Input #1, mystring
Next i

answer = Mid(mystring, 25, 15)
Close #1

Worksheets(1).Range("C2").Value = Val(answer)

End Sub
```

Appendix 2 COSTAR Commands.txt file

This is a list of the Costar V4, V5, and V6 commands.

From the V4 manual....
==
The terms used in the command summary are defined in the following table:

Term	Definition
brkpercent	An integer between 0 and 99.
cdvalue	One of the following: a cost driver rating such as Low or Very high; an effort multiplier such as 1.25; an asterisk ("*").
component-name	A 1 to 12 character string. The first character must be a letter (either uppercase or lowercase). The other characters may be letters, numbers, periods, hyphens, or underscores.
cost	A number between 0 and 99999.
ctext	A one line comment.
database-name	A 1 to 12 character string. The first character must be a letter (either uppercase or lowercase). The other characters may be letters, numbers, periods, hyphens, or underscores.
delay	A number between -9.9 and 99.9.
dsivalue	A number between 0 and 9999999.
estimate-name	A 1 to 12 character string. The first character must be a letter (either uppercase or lowercase). The other characters may be letters, numbers, periods, hyphens, or underscores.
filename	A character string representing a filename.
help-name	The name of a Costar command, or a special help topic such as "Reports" or "Commands".
id	A 1 to 4 character string.
increment	An integer between 1 and 20.
mcdvalue	One of the following: a cost driver rating such as Low or Very High; an effort multiplier such as 1.25; an asterisk ("*"); an equals sign ("=").
milestone	An integer between 0 and 6.
mode	Organic, Semidetached, or Embedded.
percent	An integer between 0 and 999.
pact	An integer between 0 and 999.
phase	An integer between 0 and 4.
planning	An integer between 0 and 5.
report-name	The name of the one of the Costar reports.
sigma	A number between 0.00 and 0.30.
startpoint	An integer between 0 and 3.
svalue	Either On or Off.
switch	The name of one of the Costar switches.

Items enclosed in [brackets] are optional parameters.

ACAP [cdvalue] [(mcdvalue)]	Analyst Capability Cost Driver
ACTIVITY	Activity Report
ADSI dsivalue	Set Adapted Delivered Source Instructions
APEX [cdvalue] [(mcdvalue)]	Applications Experience Cost Driver
APM sigma	Ada Process Model Conformance
ARCHIVE	Archive Report
CALCMODEL [I] [D]	Set Calculation Model
CBREAKAGE	Cost & Breakage Report
CLEF	CLEF Report
CM percent	Set Percent Code Modified
COMMENT [ctext]	Record Comment for Component
COMPONENT component-name	Create Component
COPY component-name	Copy Component
COST	Cost Profile Report
CPI planning	Set Conversion Planning Increment
CPLX [cdvalue] [(mcdvalue)]	Product Complexity Cost Driver
CTCOST cost	Set Code and Unit Test Cost
DATA [cdvalue] [(mcdvalue)]	Database Size Cost Driver
DBDELETE database-name	Delete Database from Memory
DBLOAD filename	Load Database from File
DBSELECT database-name	Select Database for Current Estimate
DDCOST cost	Set Detailed Design Cost
DELETE component-name	Delete Component
DETAIL	Detail Report
DISPLAY [report-name] [[(]estimate-names[)]]	Display Report

DM percent	Set Percent Design Modified
DSI dsivalue	Set Delivered Source Instructions
EBREAKAGE	Effort & Breakage Report
ESTCOMMENT [ctext]	Record Comment for Current Estimate
ESTCOMPARE [estimate-names]	Comparison Report
ESTCOPY estimate-name	Create a Duplicate of Current Estimate
ESTCREATE estimate-name	Create a New Estimate
ESTDELETE estimate-name	Delete Estimate from Memory
ESTID [id]	Assign ID to Current Estimate
ESTNAME [estimate-name]	Assign Name to Current Estimate
ESTSELECT estimate-name	Select Current Estimate
GCOST	Graph Cost vs. Time
GMILESTONE	Graph Milestones vs. Time
GOTO component-name	Set New Current Component
GSTAFF	Graph Staff vs. Time
HELP [help-name]	Display Help Message
ID [id]	Assign ID to Current Component
IM percent	Set Percentage of Integration Required for Modification
INCDETAILS	Increment Detail Report
INCREMENT [increment]	Assign Component to an Increment
INCSUMMARY	Increment Summary Report
ITCOST cost	Set Integration & Test Cost
LEXP [cdvalue] [(mcdvalue)]	Programming Language Experience Cost Driver
LOAD filename	Load Project Estimation Data
MNAPM sigma	Maintenance Ada Process Model Conformance
MNCOST cost	Set Maintenance Cost
MODE mode	Set Development Mode
MODP [cdvalue] [(mcdvalue)]	Use of Modern Programming Practices Cost Driver
MOVE component-name	Move Component
NAMES	Names Report
NDSI	Set Newly Created Delivered Source Instructions
PACT pact	Set Percentage Annual Change Traffic
PCAP [cdvalue] [(mcdvalue)]	Programmer Capability Cost Driver
PDCOST cost	Set Product Design Cost
PRINT report-name [(estimate-names)] [filename]	Format Report for Printer
PROFILE	Write Profile
QUIT	Exit Program
READ	Read Commands from File
REDRAW	Redraw Screen
RELY [cdvalue]	Required Software Reliability Cost Driver
RENAME component-name	Rename Current Component
RQCOST cost	Set Requirements Analysis Cost
RUSE [cdvalue]	Required Reusability Cost Driver
SAVE filename	Save Project Estimation Data
SCED [cdvalue]	Required Development Schedule Cost Driver
SCHEDULE	Schedule Report
SECU [cdvalue] [(mcdvalue)]	Classified Security Application Cost Driver
SET switch svalue	Set Switch
SHOW	Show Project Hierarchy
STAFF	Staffing Profile
STOR [cdvalue] [(mcdvalue)]	Main Storage Constraint Cost Driver
STRUCTURE	Structure Report
SUBCOMPONENT component-name	Create Subcomponent
SUMMARY	Summary Report
TIME [cdvalue] [(mcdvalue)]	Execution Time Constraint Cost Driver
TOOL [cdvalue] [(mcdvalue)]	Use of Software Tools Cost Driver
TURN [cdvalue] [(mcdvalue)]	Computer Turnaround Time Cost Driver
USRn [cdvalue] [(mcdvalue)]	User Defined Cost Driver
VEXP [cdvalue] [(mcdvalue)]	Virtual Machine Experience Cost Driver
VIRT [cdvalue] [(mcdvalue)]	Virtual Machine Volatility Cost Driver
VMVH [cdvalue] [(mcdvalue)]	Virtual Machine Volatility - Host Cost Driver
VMVT [cdvalue] [(mcdvalue)]	Virtual Machine Volatility - Target Cost Driver
WRITE filename	Write Costar Commands to File
WSAPM factor weight	Worksheet Ada Process Model Conformance
WSBREAKAGE increment brkpercent	Worksheet Breakage
WSCA row column complexity	Worksheet Complexity Adjustment
WSCOST class year cost	Worksheet Labor Cost
WSDELAY increment phase delay	Worksheet Delay

WSDISTRIB phase % % % % % % %	Worksheet Labor Distribution
WSDSIPFP lines	Worksheet DSI per Function Point
WSFP factor complexity count	Worksheet Function Points
WSLANGUAGE language	Worksheet Language
WSMILESTONE increment milestone	Worksheet Milestone
WSNAME class name	Worksheet Labor Class Name
WSPCAF adjustment	Worksheet Processing Complexity Adjustment Factor
WSSTARTPOINT startpoint	Worksheet Startpoint

==

The annotated commands are new in 5.0.

ACAP	
ACTIVITY	
ADSI	
APEX	
AMCF	Annual Maintenance Change Factor. 0..999
APM	
ARCHIVE	
ASSESSMENT	0..999 or "a".."e" for the radio buttons 0..8.
BRAK	Breakage. 0..999
CALCMODEL	
CBREAKAGE	
PLEX	PEXP
LTEX	LTEX
PCON	PCON
CD03	SITE
CD04	PVOL
CD05	DOCU
CD06	unused
CD07	unused
CD08	unused
CD09	unused
CD90	RCPX
CD91	PDIF
CD92	PERS
CD93	PREX
CD94	FCIL
CD95	unused
CLEF	
CM	
COMMENT	
COMPONENT	
COPY	
COST	
CPI	
CPLX	
CTCOST	
CUTCOST	
DATA	
DBDELETE	
DBLOAD	
DBSELECT	
DDCOST	
DELETE	
DETAILS	
DISPLAY	
DM	
DSI	
EBREAKAGE	
EDSI	
ESTCOMMENT	
ESTCOMPARE	
ESTCOPY	
ESTCREATE	
ESTDELETE	
ESTID	
ESTIMATE	
ESTLOAD	

ESTNAME	
ESTSELECT	
EXIT	
FLEX	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
GOTO	
GCOST	
GMILESTONES	
GSTAFF	
HELP	
ID	
IM	
INCDETAILS	
INCREMENT	
INCSUMMARY	
ITCOST	
LEXP	
LOAD	
MILESTONES	
MNCOST	
MODE	
MODP	
MOVE	
MNAPM	
MNUNDERSTAND	0..999 or "b".."f" for radio buttons 10..50.
MNUNFAMILIAR	0.0..1.0 or "a".."f" for radio buttons 0.0..1.0.
NAMES	
NDSI	
PACT	
PARAMETER	
PCAP	
PDCOST	
PMAT	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
PREC	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
PRINT	
PROFILE	
QUIT	
READ	
REDRAW	
RELY	
RENAME	
RESL	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
RESULTS	
RQCOST	
RUSE	
SAVE	
SCED	
SECU	
STOR	
SCHEDULE	
SET	
SHOW	
SIZING	Sizing report.
STAFF	
STRUCTURE	
SUBCOMPONENT	
SUMMARY	
SWUNDERSTAND	0..999 or "b".."f" for radio buttons 10..50.
TEAM	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
TIME	
TOOL	
TURN	
UNFAMILIAR	0.0..1.0 or "a".."f" for radio buttons 0.0..1.0.
USR1	
USR2	
USR3	
USR4	
USR5	
USR6	

USR7
USR8
USR9
VEXP
VIRT
VMVH
VMVT
WRITE
WSAPM
WSBREAKAGE
WSCA
WSCOST
WSDELAY
WSDISTRIB
WSDSIPFP
WSFP
WSLANGUAGE
WSMILESTONE
WSNAME
WSPCAF
WSSTARTPOINT

==

New in V5....

==

AMCF	Annual Maintenance Change Factor. 0..999
ASSESSMENT	0..999 or "a".."e" for the radio buttons 0..8.
BRAK	Breakage. 0..999
FLEX	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
MNUNDERSTAND	0..999 or "b".."f" for radio buttons 10..50.
MNUNFAMILIAR	0.0..1.0 or "a".."f" for radio buttons 0.0..1.0.
PMAT	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
PREC	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
RESL	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
SIZING	Sizing report.
SWUNDERSTAND	0..999 or "b".."f" for radio buttons 10..50.
TEAM	Scale Driver. 0..7. 0 = Extra Low 7 = Extra Extra High.
UNFAMILIAR	0.0..1.0 or "a".."f" for radio buttons 0.0..1.0.

....new cost drivers (same format as old ones)....

==

New in V6....

==

TXCOST cost	Set Taxation Phase Cost
MAINTSIZE	Sizing report.

==

Appendix 3 Modified COSTAR VBA code

**Excel workbook must have one worksheet named "Data" and another named "Experiment"
**This code is for 6 factors only.

Module 1

```
Option Explicit
Public FactorNames(10), FactorLevels(10, 3), NumofFactors As Integer
Public NumofLevels As Integer



Sub CreateCostarExperimentMatrix()
Dim Currentlinecount As Integer
Dim RunNumber As Integer, ProjectName As String, i As Integer, j As Integer
Dim a As Integer, b As Integer, c As Integer, d As Integer, e As Integer, f As Integer

Currentlinecount = 0
RunNumber = 0
Worksheets("Data").Select
NumofFactors = Cells(2, 4)
NumofLevels = Cells(3, 4)
ProjectName = Cells(1, 4)
'
'  Read in factor names and levels
'
For i = 1 To NumofFactors

   FactorNames(i) = Cells(i + 4, 3)
   For j = 1 To 3
      FactorLevels(i, j) = Cells(i + 4, 3 + j)
   Next j

Next i

Worksheets("Experiment").Select
'
'  Create the actual experiment
'
Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = "Run"
Cells(Currentlinecount, 2) = "New Lines of Code"
Cells(Currentlinecount, 3) = FactorNames(1)
Cells(Currentlinecount, 4) = FactorNames(2)
Cells(Currentlinecount, 5) = FactorNames(3)
Cells(Currentlinecount, 6) = FactorNames(4)
Cells(Currentlinecount, 7) = FactorNames(5)
Cells(Currentlinecount, 8) = FactorNames(6)
Cells(Currentlinecount, 9) = "Effort Months"
```

```
For a = 1 To 3
For b = 1 To 3
For c = 1 To 3
For d = 1 To 3
For e = 1 To 3
For f = 1 To 3
Currentlinecount = Currentlinecount + 1
RunNumber = RunNumber + 1
Cells(Currentlinecount, 1) = "Costar " & RunNumber
Cells(Currentlinecount, 2) = "40000"
Cells(Currentlinecount, 3) = FactorLevels(1, a)
Cells(Currentlinecount, 4) = FactorLevels(2, b)
Cells(Currentlinecount, 5) = FactorLevels(3, c)
Cells(Currentlinecount, 6) = FactorLevels(4, d)
Cells(Currentlinecount, 7) = FactorLevels(5, e)
Cells(Currentlinecount, 8) = FactorLevels(6, f)

Next f
Next e
Next d
Next c
Next b
Next a
' Run the settings through Costar
Call docostar

End Sub
```

Module 2

Sub docostar()

```
'
'   Proof of concept.
'       1)  Use values from arrays to create a file of Costar commands, "Costar.cmd"
'       2)  Execute Costar, writing an ASCII version of a report, "costar.out"
'       3)  Extract results from the report, put them into "Experiment" spreadsheet
'
Dim exe
Dim tempdir
Dim found
Dim i As Integer, Currentlinecount As Integer
Dim mystring
Dim answer
'
Application.ScreenUpdating = False
Currentlinecount = 1
Worksheets("Data").Select
NumofFactors = Cells(2, 4)
NumofLevels = Cells(3, 4)
'
'  Read in factor names and levels
'
For i = 1 To NumofFactors
```

```
    FactorNames(i) = Cells(i + 4, 3)
    For j = 1 To 3
        FactorLevels(i, j) = Cells(i + 4, 3 + j)
    Next j

Next i

'   Find TEMP directory
'
tempdir = Environ("TEMP")

If tempdir = "" Then tempdir = "c:"

If Right(tempdir, 1) <> "\" Then tempdir = tempdir + "\"
'
'   Find Costar executable
'
exe = "c:\Program Files\Softstar\Costar 6\costar.exe"
found = Dir(exe)

If found <> "costar.exe" Then
   exe = "\Program Files\Softstar\Costar 6.0\costar.exe"
   found = Dir(exe)
End If

If found <> "costar.exe" Then
   exe = "\Program Files\Softstar\Costar 6 Demo\costar.exe"
   found = Dir(exe)
End If

If found <> "costar.exe" Then exe = "c:\costar.exe"
'
'   Write file of Costar commands
'
For a = 1 To 3
    For b = 1 To 3
        For c = 1 To 3
            For d = 1 To 3
                For e = 1 To 3
                    For f = 1 To 3
                    Currentlinecount = Currentlinecount + 1
                    Open tempdir + "Costar.cmd" For Output As #1
                    Print #1, FactorNames(1); FactorLevels(1, a)
                    Print #1, FactorNames(2); FactorLevels(2, b)
                    Print #1, FactorNames(3); FactorLevels(3, c)
                    Print #1, FactorNames(4); FactorLevels(4, d)
                    Print #1, FactorNames(5); FactorLevels(5, e)
                    Print #1, FactorNames(6); FactorLevels(6, f)
                    Print #1, "dsi "; Worksheets("Experiment").Cells(Currentlinecount, 2).Value
                    Print #1, "print detail "; tempdir + "costar.out"
                    Print #1, "save "; tempdir + "temp.cst"
                    Print #1, "quit"
                    Close #1
'
```

```
'   Execute Costar
'
RetVal = Shell(exe + " " + tempdir + "costar.cmd", vbNormalFocus)
'
'   Read Costar results
'
Open tempdir + "costar.out" For Input As #1

For i = 1 To 17
  Input #1, mystring
Next i

answer = Mid(mystring, 25, 15)
Close #1
Worksheets("Experiment").Cells(Currentlinecount, 9).Value = Val(answer)

                Next f
             Next e
          Next d
       Next c
   Next b
Next a

End Sub
```

Appendix 4 SEER-SEM VBA Code

Module 1

```
Sub CreateSeerExperimentMatrix()
Dim FactorNames(10)
Dim FactorLevels(10, 3)
Dim NumofFactors As Integer
Dim NumofLevels As Integer
Dim Currentlinecount As Integer
Dim RunNumber As Integer

Currentlinecount = 1
RunNumber = 0
Worksheets("Data").Select
NumofFactors = Cells(2, 4)
NumofLevels = Cells(3, 4)
ProjectName = Cells(1, 4)
'
'  Read in factor names and levels
'
For i = 1 To NumofFactors

   FactorNames(i) = Cells(i + 4, 3)
   For j = 1 To 3
      FactorLevels(i, j) = Cells(i + 4, 3 + j)
   Next j

Next i

Worksheets("Experiment").Select

'
'  Create the actual experiment
'
Cells(1, 1) = "ProjectCreate"
Cells(1, 2) = "SEER"
Cells(1, 3) = ProjectName
For a = 1 To 3
For b = 1 To 3
For c = 1 To 3
For d = 1 To 3
For e = 1 To 3
For f = 1 To 3
Currentlinecount = Currentlinecount + 1
RunNumber = RunNumber + 1
Cells(Currentlinecount, 1) = "WBSCreate"
Cells(Currentlinecount, 2) = "SEER " & RunNumber
Cells(Currentlinecount, 3) = "Program"
Cells(Currentlinecount, 4) = "1"

Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = "New Lines of Code"
```

```
Cells(Currentlinecount, 2) = "40000"
Cells(Currentlinecount, 3) = "40000"
Cells(Currentlinecount, 4) = "40000"

Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = FactorNames(1)
Cells(Currentlinecount, 2) = FactorLevels(1, a)
Cells(Currentlinecount, 3) = FactorLevels(1, a)
Cells(Currentlinecount, 4) = FactorLevels(1, a)

Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = FactorNames(2)
Cells(Currentlinecount, 2) = FactorLevels(2, b)
Cells(Currentlinecount, 3) = FactorLevels(2, b)
Cells(Currentlinecount, 4) = FactorLevels(2, b)

Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = FactorNames(3)
Cells(Currentlinecount, 2) = FactorLevels(3, c)
Cells(Currentlinecount, 3) = FactorLevels(3, c)
Cells(Currentlinecount, 4) = FactorLevels(3, c)

Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = FactorNames(4)
Cells(Currentlinecount, 2) = FactorLevels(4, d)
Cells(Currentlinecount, 3) = FactorLevels(4, d)
Cells(Currentlinecount, 4) = FactorLevels(4, d)

Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = FactorNames(5)
Cells(Currentlinecount, 2) = FactorLevels(5, e)
Cells(Currentlinecount, 3) = FactorLevels(5, e)
Cells(Currentlinecount, 4) = FactorLevels(5, e)

Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = FactorNames(6)
Cells(Currentlinecount, 2) = FactorLevels(6, f)
Cells(Currentlinecount, 3) = FactorLevels(6, f)
Cells(Currentlinecount, 4) = FactorLevels(6, f)

Next f
Next e
Next d
Next c
Next b
Next a

Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = "FlexportOutput"
Cells(Currentlinecount, 2) = "SEER DOE" 'Custom flexible export report to capture parameter values and
effort.
Cells(Currentlinecount, 3) = "SEER DOE.txt"

Currentlinecount = Currentlinecount + 1
```

```
Cells(Currentlinecount, 1) = "SaveProjectFiles"
Cells(Currentlinecount, 2) = "SEER DOE"

End Sub
```

Module 2

```
Sub SEERDataFormat()
'Format data results from SEER report
Application.ScreenUpdating = False
    Rows("2:2").Delete
    Rows("1:1").Select
        With Selection
            .HorizontalAlignment = xlCenter
            .VerticalAlignment = xlCenter
            .WrapText = True
            .Orientation = 0
            .AddIndent = False
            .IndentLevel = 0
            .ShrinkToFit = False
            .ReadingOrder = xlContext
            .MergeCells = False
        End With
        Columns("A:A").ColumnWidth = 12.57
        Columns("B:B").ColumnWidth = 10.86
        Columns("C:C").ColumnWidth = 10.86
        Columns("D:D").ColumnWidth = 11.57
        Columns("E:E").ColumnWidth = 13.14
        Columns("F:F").ColumnWidth = 12
        Columns("G:G").ColumnWidth = 11.43
        Columns("H:H").ColumnWidth = 15.86
        Columns("I:I").ColumnWidth = 12.43
        Selection.RowHeight = 45.75
    Columns("A:A").Select
        Selection.Font.Bold = True
    Range("A1:I1").Select
        Selection.Font.Bold = True
        Selection.Borders(xlDiagonalDown).LineStyle = xlNone
        Selection.Borders(xlDiagonalUp).LineStyle = xlNone
        With Selection.Borders(xlEdgeLeft)
            .LineStyle = xlContinuous
            .Weight = xlThin
            .ColorIndex = xlAutomatic
        End With
        With Selection.Borders(xlEdgeTop)
            .LineStyle = xlContinuous
            .Weight = xlThin
            .ColorIndex = xlAutomatic
        End With
        With Selection.Borders(xlEdgeBottom)
            .LineStyle = xlContinuous
            .Weight = xlThin
            .ColorIndex = xlAutomatic
```

```
        End With
        With Selection.Borders(xlEdgeRight)
            .LineStyle = xlContinuous
            .Weight = xlThin
            .ColorIndex = xlAutomatic
        End With
        With Selection.Borders(xlInsideVertical)
            .LineStyle = xlContinuous
            .Weight = xlThin
            .ColorIndex = xlAutomatic
        End With
Cells(1, 1).Select
End Sub

Sub SelectData()

With Range("A1")
    Range(.Cells(1, 1), .End(xlDown).Offset(0, 3)).Copy
End With

End Sub
```

Appendix 5 SLIM VBA Code

Module 1

```
Sub CreateSLIMExperimentMatrix()
Dim FactorNames(10)
Dim FactorLevels(10, 3)
Dim NumofFactors As Integer
Dim NumofLevels As Integer
Dim Currentlinecount As Integer
Dim RunNumber As Integer

Currentlinecount = 0
RunNumber = 0
Worksheets("Data").Select
NumofFactors = Cells(2, 4)
NumofLevels = Cells(3, 4)
ProjectName = Cells(1, 4)
'
'  Read in factor names and levels from Data worksheet
'
For i = 1 To NumofFactors

   FactorNames(i) = Cells(i + 4, 3)
   For j = 1 To 3
      FactorLevels(i, j) = Cells(i + 4, 3 + j)
   Next j

Next i

Worksheets("Experiment").Select

'
'  Create the actual experiment
'
Currentlinecount = Currentlinecount + 1
Cells(Currentlinecount, 1) = "Run"
Cells(Currentlinecount, 2) = FactorNames(1)
Cells(Currentlinecount, 3) = FactorNames(2)
Cells(Currentlinecount, 4) = FactorNames(3)
Cells(Currentlinecount, 5) = FactorNames(4)
Cells(Currentlinecount, 6) = FactorNames(5)
Cells(Currentlinecount, 7) = FactorNames(6)
Cells(Currentlinecount, 8) = "Effort Months"
Cells(Currentlinecount, 9) = "Change from Nominal"

For a = 1 To 3
For b = 1 To 3
For c = 1 To 3
For d = 1 To 3
For e = 1 To 3
For f = 1 To 3
```

```
Currentlinecount = Currentlinecount + 1
RunNumber = RunNumber + 1
Cells(Currentlinecount, 1) = "SLIM " & RunNumber
Cells(Currentlinecount, 2) = FactorLevels(1, a)
Cells(Currentlinecount, 3) = FactorLevels(2, b)
Cells(Currentlinecount, 4) = FactorLevels(3, c)
Cells(Currentlinecount, 5) = FactorLevels(4, d)
Cells(Currentlinecount, 6) = FactorLevels(5, e)
Cells(Currentlinecount, 7) = FactorLevels(6, f)

Next f
Next e
Next d
Next c
Next b
Next a

' Format Experiment Matrix
Range("A1:I1").Select
With Selection.Borders(xlEdgeLeft)
        .LineStyle = xlContinuous
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    With Selection.Borders(xlEdgeTop)
        .LineStyle = xlContinuous
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    With Selection.Borders(xlEdgeBottom)
        .LineStyle = xlContinuous
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    With Selection.Borders(xlEdgeRight)
        .LineStyle = xlContinuous
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    With Selection.Borders(xlInsideVertical)
        .LineStyle = xlContinuous
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
    End With
    Selection.Font.Bold = True
    Range("I1").Select
    With Selection
        .WrapText = True
    End With
End Sub
```

Appendix 6 PRICE S APPL Values

Type of Application	APPL Value	Description	Stat/ Math	String Manipulation	GUI	Storage and	Graphical Functions	On-line comm.	Control Functions	Real Time	Interactive	Operating System	Logical Functions
Text Processors	2.89	A system that handles text. Text processing software is used to create, store, edit, print and display text. Examples of text processing systems include word processors, text editors and search engines.	5%	50%	25%	20%			0%				
Accounting packages	3.02	Systems designed to help businesses plan and manage their finances, Examples include Oros, Hyperion	25%	15%	25%	20%	15%						
Data Processing	3.06	A generic description for any software system that handles the entering, storing, updating, and retrieving of information for any number of purposes. These systems are heavy in data storage and retrieval, string processing and user interface. Examples include systems which produce credit card statements or keep records	10%	35%	15%	40%							
Internet Applications	3.16	Applications developed for use on the Internet. These systems generally consist of a browser based component and other small applets to implement more complex functionality. These systems are characterized byconsiderable text manipulation and strong GUI components. Examples include Encarta Encyclopedia, on-line dictionary, on-line shopping,	22%	28%	15%	15%	5%	15%					
Material Requirement Planning (MRP)	3.19	A system that manages and provides instant access to information about orders, forecasts, production plans, and key performance indicators such as inventory levels and filling rates. MRP systems are intended to help increase service quality and reduce investments in inventory. Among the modules of an MRP system are: purchasing (including business-to-business procurement), business information data warehousing, logistics operations, materials and property management, production planning, and supply chain management. Modern MRP Systems will use the Internet to extend information across and outside an enterprise to partners and/or customers.	25%	10%	15%	42%		8%					
Financial Operation Systems	3.33	A system to manage enterprise financial and/or treasury operations; includes functions of capital investment management, financial monitoring, portfolio management, contract management, financial accounting, and investment management; operation is controlled and integrated to allow collaborative data management while maintaining integrity and confidentiality; examples: SAP Financials, BaanERP Financials, Solomon, J.D. Edwards Financial Management.	20%	25%	5%	30%	5%	15%					
MIS	3.56	A system that helps managers to run their company. A system for gathering the financial, production, and other information that managers need to operate a business, especially a system that is computerized. MIS Systems have intensive data storage and	17%	8%	15%	43%	10%	7%					
Office Automation	3.68	word processing, accounting, and e-mail - intended to replace functions previously performed manually. Office automation systems almost always involve a network of computers sharing functionality and/or data. Examples of office automation	10%	20%	15%	30%	15%	10%		0%			

Type of Application	APPL Value	Description	Stat/ Math	String Manipulation	GUI	Storage and	Graphical Functions	On-line comm.	Control Functions	Real Time	Interactive	Operating System	Logical Functions
Customer Relationship Management (CRM) Systems	3.70	A system that helps manage the interaction functions in engaging, transacting, fulfilling, and servicing customers; includes functions of role-based workplaces, interfaces to front-office interaction and back-office fulfillment, channel synchronization, customer behavior analysis, customer acquisition and retention, and collaborative applications that support customers, suppliers, and business partners. Examples: SAP CRM, Seibel, ACT.	12%	20%	10%	33%	10%	15%					
Purchasing/Inventory Control	3.80	Software system design to control and manage inventory and purchasing processes such as order/replensihment cycle, saftey stock, notification to buyer purchase needs. Examples: DRP (Distribution Requirments Planning) portion of an ERP system	15%	10%	15%	30%	15%	15%					
Human Resources Applications	3.90	Software designed to manage all of the aspects of a business related to having employees - including software that manages payroll, records time, maintains employee policies, etc.	5%	15%	25%	30%	13%	12%	0%	0%			
Database systems	3.95	Database systems are systems designed to facilitate the storage and retrieval of large amounts of data in such a way that location of specific data is efficient. Examples of database systems include Oracle, SQL Server, MS Acces	0%	25%	18%	32%	10%	15%	0%	0%			
Fleet Management	3.97	A system that aids in the scheduling, dispatching, and routing of aircraft and/or ground vehicles; incorporates a GUI interface with powerful database management; examples: PFM (Professional Flight Manager).	15%	20%	15%	25%	5%	5%	10%			0%	5%
Expert or Decision Support System	4.15	A system that retrieves and processes information according to dynamic rules. Processing will be sensitive to conditional responses. Applications usually contain many graphic and text reports to provide detailed interpretations of results. Examples: Analytical Hierarchy Process software, Crystal Ball, PRICE Models.	15%	10%	20%	30%	15%						10%
ERP Systems	4.18	An ERP system is a system designed to integrate all departments and functions across a company into a single computer system that can serve all those department's different needs. Examples include SAP and Oracle Apps	12%	13%	18%	25%	12%	8%	0%	12%			
Health Monitoring System	4.52	Software that monitors the health of a vehicle's trajectory after a space launch. In the event of failure the vehicle may be destroyed to prevent it from crashing to Earth. Example: Missile Launch Control	25%	25%		15%		15%			20%		
Imaging, Sensing & Mapping	4.64	A system that receives and processes visual information; incorporating features such as: filtering (high and low pass, erosion, and convolution), magnifying, orienting, pixel alteration, image stacks, device control, journaling, rapid morphometry, pattern recognition of multivariate numerical data. Examples: Astroart, MetaMorph, IUE, ToolDiag, Magellan GPS, TerraWeb.	20%	10%		25%	25%			10%			10%
Telecommunications	5.96	Systems designed for communication over a distance by electronic transmission of impulses as by telegraph, cable, telephone, radio, or television. Examples: LAN, WAN, Internet, and Intranets.		18%	14%			50%				10%	8%
Flight Management	6.20	A system that processes and presents flight systems information for operator action; functions monitored include: air speed, direction, altitude, orientation, and major system status.	8%	10%	5%	20%	10%		10%	15%	14%	5%	3%
Satellite Data Link	7.10	Software that facilitate satellite communication	5%	8%		15%		14%	9%	25%	0%		24%
Text Based Operating System	7.41	Software that implements an Operating System for a computer that is text based such as DOS or UNIX. Functionality performed includes memory management, timing, process management	10%	10%		21%				9%		50%	

Type of Application	APPL Value	Description	Stat/ Math	String Manipulation	GUI	Storage and	Graphical Functions	On-line comm.	Control Functions	Real Time	Interactive	Operating System	Logical Functions
Weapons Management	7.58	Weapon management software controls the inventory of available weapons for pilot selection; downloads target information to the weapon; Depending on weapon type, the SMS may control the launch and flight of the weapon.	5%	5%		12%		18%		30%	10%		20%
Graphical Operating System	7.60	Software that implements a Graphical Operating System such as the MAC Operating System or Windows NT,2000. Functionality performed includes memory management, timing, process management	10%	10%	5%	10%	5%			5%	5%	50%	
Encryption Applications	7.73	Software designed for encryption and decryption of code, passwords, email etc. This would include both symmetric and asymmetric cryptosystems. Examples: Communications security software and licensing code for software applications.	20%	10%		5%							65%
Weapon Control	7.77	Software designed to plan, coordinate, and control the firing of offensive weapons such as missiles and guns. This software communicates via data link with the aircraft for target location (dumb weapon), or in terms of a fire and forget weapon it uses downloaded information for its flight profile to target location. Examples: Fire Control Computer, missile guidance, artillary pointing	5%	5%		15%		15%		20%	15%		25%
Guidance Control	7.86	Software designed to guide a missile or projectile to destroy the target. Guidance control works with radar tracking and fire control for the complete target engagement process. Examples: Guided Missiles lauched from surface, air, space, or underwater.	10%	5%		10%		15%		10%	10%	10%	30%

Appendix 7 COSTAR Data Table

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 1	1.42	1.34	1.29	1.22	1.19	1.2	726.40	4.28	4.28
Costar 2	1.42	1.34	1.29	1.22	1.19	1	605.40	3.56	3.56
Costar 3	1.42	1.34	1.29	1.22	1.19	0.84	508.50	2.99	2.99
Costar 4	1.42	1.34	1.29	1.22	1	1.2	610.50	3.59	3.59
Costar 5	1.42	1.34	1.29	1.22	1	1	508.70	2.99	2.99
Costar 6	1.42	1.34	1.29	1.22	1	0.84	427.30	2.52	2.52
Costar 7	1.42	1.34	1.29	1.22	0.85	1.2	518.90	3.05	3.05
Costar 8	1.42	1.34	1.29	1.22	0.85	1	432.40	2.55	2.55
Costar 9	1.42	1.34	1.29	1.22	0.85	0.84	363.20	2.14	2.14
Costar 10	1.42	1.34	1.29	1	1.19	1.2	595.40	3.50	3.51
Costar 11	1.42	1.34	1.29	1	1.19	1	496.20	2.92	2.92
Costar 12	1.42	1.34	1.29	1	1.19	0.84	416.80	2.45	2.45
Costar 13	1.42	1.34	1.29	1	1	1.2	500.40	2.95	2.95
Costar 14	1.42	1.34	1.29	1	1	1	417.00	2.45	2.45
Costar 15	1.42	1.34	1.29	1	1	0.84	350.30	2.06	2.06
Costar 16	1.42	1.34	1.29	1	0.85	1.2	425.30	2.50	2.50
Costar 17	1.42	1.34	1.29	1	0.85	1	354.40	2.09	2.09
Costar 18	1.42	1.34	1.29	1	0.85	0.84	297.70	1.75	1.75
Costar 19	1.42	1.34	1.29	0.81	1.19	1.2	482.30	2.84	2.84
Costar 20	1.42	1.34	1.29	0.81	1.19	1	401.90	2.37	2.37
Costar 21	1.42	1.34	1.29	0.81	1.19	0.84	337.60	1.99	1.99
Costar 22	1.42	1.34	1.29	0.81	1	1.2	405.30	2.39	2.39
Costar 23	1.42	1.34	1.29	0.81	1	1	337.80	1.99	1.99
Costar 24	1.42	1.34	1.29	0.81	1	0.84	283.70	1.67	1.67
Costar 25	1.42	1.34	1.29	0.81	0.85	1.2	344.50	2.03	2.03
Costar 26	1.42	1.34	1.29	0.81	0.85	1	287.10	1.69	1.69
Costar 27	1.42	1.34	1.29	0.81	0.85	0.84	241.20	1.42	1.42
Costar 28	1.42	1.34	1	1.22	1.19	1.2	563.10	3.31	3.31
Costar 29	1.42	1.34	1	1.22	1.19	1	469.30	2.76	2.76
Costar 30	1.42	1.34	1	1.22	1.19	0.84	394.20	2.32	2.32
Costar 31	1.42	1.34	1	1.22	1	1.2	473.20	2.79	2.79
Costar 32	1.42	1.34	1	1.22	1	1	394.40	2.32	2.32
Costar 33	1.42	1.34	1	1.22	1	0.84	331.30	1.95	1.95
Costar 34	1.42	1.34	1	1.22	0.85	1.2	402.20	2.37	2.37
Costar 35	1.42	1.34	1	1.22	0.85	1	335.20	1.97	1.97
Costar 36	1.42	1.34	1	1.22	0.85	0.84	281.60	1.66	1.66
Costar 37	1.42	1.34	1	1	1.19	1.2	461.60	2.72	2.72
Costar 38	1.42	1.34	1	1	1.19	1	384.70	2.26	2.26
Costar 39	1.42	1.34	1	1	1.19	0.84	323.10	1.90	1.90
Costar 40	1.42	1.34	1	1	1	1.2	387.90	2.28	2.28
Costar 41	1.42	1.34	1	1	1	1	323.20	1.90	1.90

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 42	1.42	1.34	1	1	1	0.84	271.50	1.60	1.60
Costar 43	1.42	1.34	1	1	0.85	1.2	329.70	1.94	1.94
Costar 44	1.42	1.34	1	1	0.85	1	274.80	1.62	1.62
Costar 45	1.42	1.34	1	1	0.85	0.84	230.80	1.36	1.36
Costar 46	1.42	1.34	1	0.81	1.19	1.2	373.90	2.20	2.20
Costar 47	1.42	1.34	1	0.81	1.19	1	311.60	1.83	1.83
Costar 48	1.42	1.34	1	0.81	1.19	0.84	261.70	1.54	1.54
Costar 49	1.42	1.34	1	0.81	1	1.2	314.20	1.85	1.85
Costar 50	1.42	1.34	1	0.81	1	1	261.80	1.54	1.54
Costar 51	1.42	1.34	1	0.81	1	0.84	219.90	1.29	1.29
Costar 52	1.42	1.34	1	0.81	0.85	1.2	267.10	1.57	1.57
Costar 53	1.42	1.34	1	0.81	0.85	1	222.60	1.31	1.31
Costar 54	1.42	1.34	1	0.81	0.85	0.84	186.90	1.10	1.10
Costar 55	1.42	1.34	0.81	1.22	1.19	1.2	456.10	2.68	2.69
Costar 56	1.42	1.34	0.81	1.22	1.19	1	380.10	2.24	2.24
Costar 57	1.42	1.34	0.81	1.22	1.19	0.84	319.30	1.88	1.88
Costar 58	1.42	1.34	0.81	1.22	1	1.2	383.30	2.26	2.26
Costar 59	1.42	1.34	0.81	1.22	1	1	319.40	1.88	1.88
Costar 60	1.42	1.34	0.81	1.22	1	0.84	268.30	1.58	1.58
Costar 61	1.42	1.34	0.81	1.22	0.85	1.2	325.80	1.92	1.92
Costar 62	1.42	1.34	0.81	1.22	0.85	1	271.50	1.60	1.60
Costar 63	1.42	1.34	0.81	1.22	0.85	0.84	228.10	1.34	1.34
Costar 64	1.42	1.34	0.81	1	1.19	1.2	373.90	2.20	2.20
Costar 65	1.42	1.34	0.81	1	1.19	1	311.60	1.83	1.83
Costar 66	1.42	1.34	0.81	1	1.19	0.84	261.70	1.54	1.54
Costar 67	1.42	1.34	0.81	1	1	1.2	314.20	1.85	1.85
Costar 68	1.42	1.34	0.81	1	1	1	261.80	1.54	1.54
Costar 69	1.42	1.34	0.81	1	1	0.84	219.90	1.29	1.29
Costar 70	1.42	1.34	0.81	1	0.85	1.2	267.10	1.57	1.57
Costar 71	1.42	1.34	0.81	1	0.85	1	222.60	1.31	1.31
Costar 72	1.42	1.34	0.81	1	0.85	0.84	186.90	1.10	1.10
Costar 73	1.42	1.34	0.81	0.81	1.19	1.2	302.80	1.78	1.78
Costar 74	1.42	1.34	0.81	0.81	1.19	1	252.40	1.49	1.49
Costar 75	1.42	1.34	0.81	0.81	1.19	0.84	212.00	1.25	1.25
Costar 76	1.42	1.34	0.81	0.81	1	1.2	254.50	1.50	1.50
Costar 77	1.42	1.34	0.81	0.81	1	1	212.10	1.25	1.25
Costar 78	1.42	1.34	0.81	0.81	1	0.84	178.10	1.05	1.05
Costar 79	1.42	1.34	0.81	0.81	0.85	1.2	216.30	1.27	1.27
Costar 80	1.42	1.34	0.81	0.81	0.85	1	180.30	1.06	1.06
Costar 81	1.42	1.34	0.81	0.81	0.85	0.84	151.40	0.89	0.89
Costar 82	1.42	1	1.29	1.22	1.19	1.2	542.10	3.19	3.19
Costar 83	1.42	1	1.29	1.22	1.19	1	451.80	2.66	2.66
Costar 84	1.42	1	1.29	1.22	1.19	0.84	379.50	2.23	2.23
Costar 85	1.42	1	1.29	1.22	1	1.2	455.60	2.68	2.68

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 86	1.42	1	1.29	1.22	1	1	379.60	2.23	2.23
Costar 87	1.42	1	1.29	1.22	1	0.84	318.90	1.88	1.88
Costar 88	1.42	1	1.29	1.22	0.85	1.2	387.20	2.28	2.28
Costar 89	1.42	1	1.29	1.22	0.85	1	322.70	1.90	1.90
Costar 90	1.42	1	1.29	1.22	0.85	0.84	271.10	1.60	1.60
Costar 91	1.42	1	1.29	1	1.19	1.2	444.40	2.62	2.62
Costar 92	1.42	1	1.29	1	1.19	1	370.30	2.18	2.18
Costar 93	1.42	1	1.29	1	1.19	0.84	311.10	1.83	1.83
Costar 94	1.42	1	1.29	1	1	1.2	373.40	2.20	2.20
Costar 95	1.42	1	1.29	1	1	1	311.20	1.83	1.83
Costar 96	1.42	1	1.29	1	1	0.84	261.40	1.54	1.54
Costar 97	1.42	1	1.29	1	0.85	1.2	317.40	1.87	1.87
Costar 98	1.42	1	1.29	1	0.85	1	264.50	1.56	1.56
Costar 99	1.42	1	1.29	1	0.85	0.84	222.20	1.31	1.31
Costar 100	1.42	1	1.29	0.81	1.19	1.2	359.90	2.12	2.12
Costar 101	1.42	1	1.29	0.81	1.19	1	299.90	1.77	1.77
Costar 102	1.42	1	1.29	0.81	1.19	0.84	252.00	1.48	1.48
Costar 103	1.42	1	1.29	0.81	1	1.2	302.50	1.78	1.78
Costar 104	1.42	1	1.29	0.81	1	1	252.10	1.48	1.48
Costar 105	1.42	1	1.29	0.81	1	0.84	211.70	1.25	1.25
Costar 106	1.42	1	1.29	0.81	0.85	1.2	257.10	1.51	1.51
Costar 107	1.42	1	1.29	0.81	0.85	1	214.20	1.26	1.26
Costar 108	1.42	1	1.29	0.81	0.85	0.84	180.00	1.06	1.06
Costar 109	1.42	1	1	1.22	1.19	1.2	420.30	2.47	2.47
Costar 110	1.42	1	1	1.22	1.19	1	350.20	2.06	2.06
Costar 111	1.42	1	1	1.22	1.19	0.84	294.20	1.73	1.73
Costar 112	1.42	1	1	1.22	1	1.2	353.20	2.08	2.08
Costar 113	1.42	1	1	1.22	1	1	294.30	1.73	1.73
Costar 114	1.42	1	1	1.22	1	0.84	247.20	1.45	1.46
Costar 115	1.42	1	1	1.22	0.85	1.2	300.20	1.77	1.77
Costar 116	1.42	1	1	1.22	0.85	1	250.10	1.47	1.47
Costar 117	1.42	1	1	1.22	0.85	0.84	210.10	1.24	1.24
Costar 118	1.42	1	1	1	1.19	1.2	344.50	2.03	2.03
Costar 119	1.42	1	1	1	1.19	1	287.10	1.69	1.69
Costar 120	1.42	1	1	1	1.19	0.84	241.10	1.42	1.42
Costar 121	1.42	1	1	1	1	1.2	289.50	1.70	1.70
Costar 122	1.42	1	1	1	1	1	241.20	1.42	1.42
Costar 123	1.42	1	1	1	1	0.84	202.60	1.19	1.19
Costar 124	1.42	1	1	1	0.85	1.2	246.00	1.45	1.45
Costar 125	1.42	1	1	1	0.85	1	205.00	1.21	1.21
Costar 126	1.42	1	1	1	0.85	0.84	172.20	1.01	1.01
Costar 127	1.42	1	1	0.81	1.19	1.2	279.00	1.64	1.64
Costar 128	1.42	1	1	0.81	1.19	1	232.50	1.37	1.37
Costar 129	1.42	1	1	0.81	1.19	0.84	195.30	1.15	1.15
Costar 130	1.42	1	1	0.81	1	1.2	234.50	1.38	1.38

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 131	1.42	1	1	0.81	1	1	195.40	1.15	1.15
Costar 132	1.42	1	1	0.81	1	0.84	164.10	0.97	0.97
Costar 133	1.42	1	1	0.81	0.85	1.2	199.30	1.17	1.17
Costar 134	1.42	1	1	0.81	0.85	1	166.10	0.98	0.98
Costar 135	1.42	1	1	0.81	0.85	0.84	139.50	0.82	0.82
Costar 136	1.42	1	0.81	1.22	1.19	1.2	340.40	2.00	2.00
Costar 137	1.42	1	0.81	1.22	1.19	1	283.70	1.67	1.67
Costar 138	1.42	1	0.81	1.22	1.19	0.84	238.30	1.40	1.40
Costar 139	1.42	1	0.81	1.22	1	1.2	286.10	1.68	1.68
Costar 140	1.42	1	0.81	1.22	1	1	238.40	1.40	1.40
Costar 141	1.42	1	0.81	1.22	1	0.84	200.20	1.18	1.18
Costar 142	1.42	1	0.81	1.22	0.85	1.2	243.10	1.43	1.43
Costar 143	1.42	1	0.81	1.22	0.85	1	202.60	1.19	1.19
Costar 144	1.42	1	0.81	1.22	0.85	0.84	170.20	1.00	1.00
Costar 145	1.42	1	0.81	1	1.19	1.2	279.00	1.64	1.64
Costar 146	1.42	1	0.81	1	1.19	1	232.50	1.37	1.37
Costar 147	1.42	1	0.81	1	1.19	0.84	195.30	1.15	1.15
Costar 148	1.42	1	0.81	1	1	1.2	234.50	1.38	1.38
Costar 149	1.42	1	0.81	1	1	1	195.40	1.15	1.15
Costar 150	1.42	1	0.81	1	1	0.84	164.10	0.97	0.97
Costar 151	1.42	1	0.81	1	0.85	1.2	199.30	1.17	1.17
Costar 152	1.42	1	0.81	1	0.85	1	166.10	0.98	0.98
Costar 153	1.42	1	0.81	1	0.85	0.84	139.50	0.82	0.82
Costar 154	1.42	1	0.81	0.81	1.19	1.2	226.00	1.33	1.33
Costar 155	1.42	1	0.81	0.81	1.19	1	188.30	1.11	1.11
Costar 156	1.42	1	0.81	0.81	1.19	0.84	158.20	0.93	0.93
Costar 157	1.42	1	0.81	0.81	1	1.2	189.90	1.12	1.12
Costar 158	1.42	1	0.81	0.81	1	1	158.30	0.93	0.93
Costar 159	1.42	1	0.81	0.81	1	0.84	132.90	0.78	0.78
Costar 160	1.42	1	0.81	0.81	0.85	1.2	161.40	0.95	0.95
Costar 161	1.42	1	0.81	0.81	0.85	1	134.50	0.79	0.79
Costar 162	1.42	1	0.81	0.81	0.85	0.84	113.00	0.67	0.67
Costar 163	1.42	0.76	1.29	1.22	1.19	1.2	412.00	2.42	2.43
Costar 164	1.42	0.76	1.29	1.22	1.19	1	343.30	2.02	2.02
Costar 165	1.42	0.76	1.29	1.22	1.19	0.84	288.40	1.70	1.70
Costar 166	1.42	0.76	1.29	1.22	1	1.2	346.20	2.04	2.04
Costar 167	1.42	0.76	1.29	1.22	1	1	288.50	1.70	1.70
Costar 168	1.42	0.76	1.29	1.22	1	0.84	242.40	1.43	1.43
Costar 169	1.42	0.76	1.29	1.22	0.85	1.2	294.30	1.73	1.73
Costar 170	1.42	0.76	1.29	1.22	0.85	1	245.20	1.44	1.44
Costar 171	1.42	0.76	1.29	1.22	0.85	0.84	206.00	1.21	1.21
Costar 172	1.42	0.76	1.29	1	1.19	1.2	337.70	1.99	1.99
Costar 173	1.42	0.76	1.29	1	1.19	1	281.40	1.66	1.66
Costar 174	1.42	0.76	1.29	1	1.19	0.84	236.40	1.39	1.39
Costar 175	1.42	0.76	1.29	1	1	1.2	283.80	1.67	1.67

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 176	1.42	0.76	1.29	1	1	1	236.50	1.39	1.39
Costar 177	1.42	0.76	1.29	1	1	0.84	198.70	1.17	1.17
Costar 178	1.42	0.76	1.29	1	0.85	1.2	241.20	1.42	1.42
Costar 179	1.42	0.76	1.29	1	0.85	1	201.00	1.18	1.18
Costar 180	1.42	0.76	1.29	1	0.85	0.84	168.90	0.99	0.99
Costar 181	1.42	0.76	1.29	0.81	1.19	1.2	273.60	1.61	1.61
Costar 182	1.42	0.76	1.29	0.81	1.19	1	228.00	1.34	1.34
Costar 183	1.42	0.76	1.29	0.81	1.19	0.84	191.50	1.13	1.13
Costar 184	1.42	0.76	1.29	0.81	1	1.2	229.90	1.35	1.35
Costar 185	1.42	0.76	1.29	0.81	1	1	191.60	1.13	1.13
Costar 186	1.42	0.76	1.29	0.81	1	0.84	160.90	0.95	0.95
Costar 187	1.42	0.76	1.29	0.81	0.85	1.2	195.40	1.15	1.15
Costar 188	1.42	0.76	1.29	0.81	0.85	1	162.80	0.96	0.96
Costar 189	1.42	0.76	1.29	0.81	0.85	0.84	136.80	0.81	0.81
Costar 190	1.42	0.76	1	1.22	1.19	1.2	319.40	1.88	1.88
Costar 191	1.42	0.76	1	1.22	1.19	1	266.20	1.57	1.57
Costar 192	1.42	0.76	1	1.22	1.19	0.84	223.60	1.32	1.32
Costar 193	1.42	0.76	1	1.22	1	1.2	268.40	1.58	1.58
Costar 194	1.42	0.76	1	1.22	1	1	223.70	1.32	1.32
Costar 195	1.42	0.76	1	1.22	1	0.84	187.90	1.11	1.11
Costar 196	1.42	0.76	1	1.22	0.85	1.2	228.10	1.34	1.34
Costar 197	1.42	0.76	1	1.22	0.85	1	190.10	1.12	1.12
Costar 198	1.42	0.76	1	1.22	0.85	0.84	159.70	0.94	0.94
Costar 199	1.42	0.76	1	1	1.19	1.2	261.80	1.54	1.54
Costar 200	1.42	0.76	1	1	1.19	1	218.20	1.28	1.28
Costar 201	1.42	0.76	1	1	1.19	0.84	183.30	1.08	1.08
Costar 202	1.42	0.76	1	1	1	1.2	220.00	1.29	1.30
Costar 203	1.42	0.76	1	1	1	1	183.30	1.08	1.08
Costar 204	1.42	0.76	1	1	1	0.84	154.00	0.91	0.91
Costar 205	1.42	0.76	1	1	0.85	1.2	187.00	1.10	1.10
Costar 206	1.42	0.76	1	1	0.85	1	155.80	0.92	0.92
Costar 207	1.42	0.76	1	1	0.85	0.84	130.90	0.77	0.77
Costar 208	1.42	0.76	1	0.81	1.19	1.2	212.10	1.25	1.25
Costar 209	1.42	0.76	1	0.81	1.19	1	176.70	1.04	1.04
Costar 210	1.42	0.76	1	0.81	1.19	0.84	148.40	0.87	0.87
Costar 211	1.42	0.76	1	0.81	1	1.2	178.20	1.05	1.05
Costar 212	1.42	0.76	1	0.81	1	1	148.50	0.87	0.87
Costar 213	1.42	0.76	1	0.81	1	0.84	124.70	0.73	0.73
Costar 214	1.42	0.76	1	0.81	0.85	1.2	151.50	0.89	0.89
Costar 215	1.42	0.76	1	0.81	0.85	1	126.20	0.74	0.74
Costar 216	1.42	0.76	1	0.81	0.85	0.84	106.00	0.62	0.62
Costar 217	1.42	0.76	0.81	1.22	1.19	1.2	258.70	1.52	1.52
Costar 218	1.42	0.76	0.81	1.22	1.19	1	215.60	1.27	1.27
Costar 219	1.42	0.76	0.81	1.22	1.19	0.84	181.10	1.07	1.07
Costar 220	1.42	0.76	0.81	1.22	1	1.2	217.40	1.28	1.28

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 221	1.42	0.76	0.81	1.22	1	1	181.20	1.07	1.07
Costar 222	1.42	0.76	0.81	1.22	1	0.84	152.20	0.90	0.90
Costar 223	1.42	0.76	0.81	1.22	0.85	1.2	184.80	1.09	1.09
Costar 224	1.42	0.76	0.81	1.22	0.85	1	154.00	0.91	0.91
Costar 225	1.42	0.76	0.81	1.22	0.85	0.84	129.40	0.76	0.76
Costar 226	1.42	0.76	0.81	1	1.19	1.2	212.10	1.25	1.25
Costar 227	1.42	0.76	0.81	1	1.19	1	176.70	1.04	1.04
Costar 228	1.42	0.76	0.81	1	1.19	0.84	148.40	0.87	0.87
Costar 229	1.42	0.76	0.81	1	1	1.2	178.20	1.05	1.05
Costar 230	1.42	0.76	0.81	1	1	1	148.50	0.87	0.87
Costar 231	1.42	0.76	0.81	1	1	0.84	124.70	0.73	0.73
Costar 232	1.42	0.76	0.81	1	0.85	1.2	151.50	0.89	0.89
Costar 233	1.42	0.76	0.81	1	0.85	1	126.20	0.74	0.74
Costar 234	1.42	0.76	0.81	1	0.85	0.84	106.00	0.62	0.62
Costar 235	1.42	0.76	0.81	0.81	1.19	1.2	171.80	1.01	1.01
Costar 236	1.42	0.76	0.81	0.81	1.19	1	143.10	0.84	0.84
Costar 237	1.42	0.76	0.81	0.81	1.19	0.84	120.20	0.71	0.71
Costar 238	1.42	0.76	0.81	0.81	1	1.2	144.30	0.85	0.85
Costar 239	1.42	0.76	0.81	0.81	1	1	120.30	0.71	0.71
Costar 240	1.42	0.76	0.81	0.81	1	0.84	101.00	0.59	0.59
Costar 241	1.42	0.76	0.81	0.81	0.85	1.2	122.70	0.72	0.72
Costar 242	1.42	0.76	0.81	0.81	0.85	1	102.20	0.60	0.60
Costar 243	1.42	0.76	0.81	0.81	0.85	0.84	85.90	0.51	0.51
Costar 244	1	1.34	1.29	1.22	1.19	1.2	511.60	3.01	3.01
Costar 245	1	1.34	1.29	1.22	1.19	1	426.30	2.51	2.51
Costar 246	1	1.34	1.29	1.22	1.19	0.84	358.10	2.11	2.11
Costar 247	1	1.34	1.29	1.22	1	1.2	429.90	2.53	2.53
Costar 248	1	1.34	1.29	1.22	1	1	358.30	2.11	2.11
Costar 249	1	1.34	1.29	1.22	1	0.84	300.90	1.77	1.77
Costar 250	1	1.34	1.29	1.22	0.85	1.2	365.40	2.15	2.15
Costar 251	1	1.34	1.29	1.22	0.85	1	304.50	1.79	1.79
Costar 252	1	1.34	1.29	1.22	0.85	0.84	255.80	1.51	1.51
Costar 253	1	1.34	1.29	1	1.19	1.2	419.30	2.47	2.47
Costar 254	1	1.34	1.29	1	1.19	1	349.40	2.06	2.06
Costar 255	1	1.34	1.29	1	1.19	0.84	293.50	1.73	1.73
Costar 256	1	1.34	1.29	1	1	1.2	352.40	2.07	2.07
Costar 257	1	1.34	1.29	1	1	1	293.60	1.73	1.73
Costar 258	1	1.34	1.29	1	1	0.84	246.70	1.45	1.45
Costar 259	1	1.34	1.29	1	0.85	1.2	299.50	1.76	1.76
Costar 260	1	1.34	1.29	1	0.85	1	249.60	1.47	1.47
Costar 261	1	1.34	1.29	1	0.85	0.84	209.70	1.23	1.23
Costar 262	1	1.34	1.29	0.81	1.19	1.2	339.70	2.00	2.00
Costar 263	1	1.34	1.29	0.81	1.19	1	283.00	1.67	1.67
Costar 264	1	1.34	1.29	0.81	1.19	0.84	237.80	1.40	1.40
Costar 265	1	1.34	1.29	0.81	1	1.2	285.40	1.68	1.68

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 266	1	1.34	1.29	0.81	1	1	237.90	1.40	1.40
Costar 267	1	1.34	1.29	0.81	1	0.84	199.80	1.18	1.18
Costar 268	1	1.34	1.29	0.81	0.85	1.2	242.60	1.43	1.43
Costar 269	1	1.34	1.29	0.81	0.85	1	202.20	1.19	1.19
Costar 270	1	1.34	1.29	0.81	0.85	0.84	169.80	1.00	1.00
Costar 271	1	1.34	1	1.22	1.19	1.2	396.60	2.33	2.33
Costar 272	1	1.34	1	1.22	1.19	1	330.50	1.95	1.95
Costar 273	1	1.34	1	1.22	1.19	0.84	277.60	1.63	1.63
Costar 274	1	1.34	1	1.22	1	1.2	333.30	1.96	1.96
Costar 275	1	1.34	1	1.22	1	1	277.70	1.63	1.63
Costar 276	1	1.34	1	1.22	1	0.84	233.30	1.37	1.37
Costar 277	1	1.34	1	1.22	0.85	1.2	283.30	1.67	1.67
Costar 278	1	1.34	1	1.22	0.85	1	236.10	1.39	1.39
Costar 279	1	1.34	1	1.22	0.85	0.84	198.30	1.17	1.17
Costar 280	1	1.34	1	1	1.19	1.2	325.10	1.91	1.91
Costar 281	1	1.34	1	1	1.19	1	270.90	1.59	1.59
Costar 282	1	1.34	1	1	1.19	0.84	227.50	1.34	1.34
Costar 283	1	1.34	1	1	1	1.2	273.20	1.61	1.61
Costar 284	1	1.34	1	1	1	1	227.60	1.34	1.34
Costar 285	1	1.34	1	1	1	0.84	191.20	1.13	1.13
Costar 286	1	1.34	1	1	0.85	1.2	232.20	1.37	1.37
Costar 287	1	1.34	1	1	0.85	1	193.50	1.14	1.14
Costar 288	1	1.34	1	1	0.85	0.84	162.50	0.96	0.96
Costar 289	1	1.34	1	0.81	1.19	1.2	263.30	1.55	1.55
Costar 290	1	1.34	1	0.81	1.19	1	219.40	1.29	1.29
Costar 291	1	1.34	1	0.81	1.19	0.84	184.30	1.08	1.08
Costar 292	1	1.34	1	0.81	1	1.2	221.30	1.30	1.30
Costar 293	1	1.34	1	0.81	1	1	184.40	1.09	1.09
Costar 294	1	1.34	1	0.81	1	0.84	154.90	0.91	0.91
Costar 295	1	1.34	1	0.81	0.85	1.2	188.10	1.11	1.11
Costar 296	1	1.34	1	0.81	0.85	1	156.70	0.92	0.92
Costar 297	1	1.34	1	0.81	0.85	0.84	131.60	0.77	0.77
Costar 298	1	1.34	0.81	1.22	1.19	1.2	321.20	1.89	1.89
Costar 299	1	1.34	0.81	1.22	1.19	1	267.70	1.58	1.58
Costar 300	1	1.34	0.81	1.22	1.19	0.84	224.90	1.32	1.32
Costar 301	1	1.34	0.81	1.22	1	1.2	269.90	1.59	1.59
Costar 302	1	1.34	0.81	1.22	1	1	224.90	1.32	1.32
Costar 303	1	1.34	0.81	1.22	1	0.84	189.00	1.11	1.11
Costar 304	1	1.34	0.81	1.22	0.85	1.2	229.40	1.35	1.35
Costar 305	1	1.34	0.81	1.22	0.85	1	191.20	1.13	1.13
Costar 306	1	1.34	0.81	1.22	0.85	0.84	160.60	0.95	0.95
Costar 307	1	1.34	0.81	1	1.19	1.2	263.30	1.55	1.55
Costar 308	1	1.34	0.81	1	1.19	1	219.40	1.29	1.29
Costar 309	1	1.34	0.81	1	1.19	0.84	184.30	1.08	1.08
Costar 310	1	1.34	0.81	1	1	1.2	221.30	1.30	1.30

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 311	1	1.34	0.81	1	1	1	184.40	1.09	1.09
Costar 312	1	1.34	0.81	1	1	0.84	154.90	0.91	0.91
Costar 313	1	1.34	0.81	1	0.85	1.2	188.10	1.11	1.11
Costar 314	1	1.34	0.81	1	0.85	1	156.70	0.92	0.92
Costar 315	1	1.34	0.81	1	0.85	0.84	131.60	0.77	0.77
Costar 316	1	1.34	0.81	0.81	1.19	1.2	213.30	1.26	1.26
Costar 317	1	1.34	0.81	0.81	1.19	1	177.70	1.05	1.05
Costar 318	1	1.34	0.81	0.81	1.19	0.84	149.30	0.88	0.88
Costar 319	1	1.34	0.81	0.81	1	1.2	179.20	1.05	1.06
Costar 320	1	1.34	0.81	0.81	1	1	149.40	0.88	0.88
Costar 321	1	1.34	0.81	0.81	1	0.84	125.50	0.74	0.74
Costar 322	1	1.34	0.81	0.81	0.85	1.2	152.30	0.90	0.90
Costar 323	1	1.34	0.81	0.81	0.85	1	126.90	0.75	0.75
Costar 324	1	1.34	0.81	0.81	0.85	0.84	106.60	0.63	0.63
Costar 325	1	1	1.29	1.22	1.19	1.2	381.80	2.25	2.25
Costar 326	1	1	1.29	1.22	1.19	1	318.10	1.87	1.87
Costar 327	1	1	1.29	1.22	1.19	0.84	267.20	1.57	1.57
Costar 328	1	1	1.29	1.22	1	1.2	320.80	1.89	1.89
Costar 329	1	1	1.29	1.22	1	1	267.40	1.57	1.57
Costar 330	1	1	1.29	1.22	1	0.84	224.60	1.32	1.32
Costar 331	1	1	1.29	1.22	0.85	1.2	272.70	1.61	1.61
Costar 332	1	1	1.29	1.22	0.85	1	227.20	1.34	1.34
Costar 333	1	1	1.29	1.22	0.85	0.84	190.90	1.12	1.12
Costar 334	1	1	1.29	1	1.19	1.2	312.90	1.84	1.84
Costar 335	1	1	1.29	1	1.19	1	260.80	1.54	1.54
Costar 336	1	1	1.29	1	1.19	0.84	219.10	1.29	1.29
Costar 337	1	1	1.29	1	1	1.2	263.00	1.55	1.55
Costar 338	1	1	1.29	1	1	1	219.10	1.29	1.29
Costar 339	1	1	1.29	1	1	0.84	184.10	1.08	1.08
Costar 340	1	1	1.29	1	0.85	1.2	223.50	1.32	1.32
Costar 341	1	1	1.29	1	0.85	1	186.30	1.10	1.10
Costar 342	1	1	1.29	1	0.85	0.84	156.50	0.92	0.92
Costar 343	1	1	1.29	0.81	1.19	1.2	253.50	1.49	1.49
Costar 344	1	1	1.29	0.81	1.19	1	211.20	1.24	1.24
Costar 345	1	1	1.29	0.81	1.19	0.84	177.40	1.04	1.04
Costar 346	1	1	1.29	0.81	1	1.2	213.00	1.25	1.25
Costar 347	1	1	1.29	0.81	1	1	177.50	1.04	1.04
Costar 348	1	1	1.29	0.81	1	0.84	149.10	0.88	0.88
Costar 349	1	1	1.29	0.81	0.85	1.2	181.10	1.07	1.07
Costar 350	1	1	1.29	0.81	0.85	1	150.90	0.89	0.89
Costar 351	1	1	1.29	0.81	0.85	0.84	126.70	0.75	0.75
Costar 352	1	1	1	1.22	1.19	1.2	296.00	1.74	1.74
Costar 353	1	1	1	1.22	1.19	1	246.60	1.45	1.45
Costar 354	1	1	1	1.22	1.19	0.84	207.20	1.22	1.22
Costar 355	1	1	1	1.22	1	1.2	248.70	1.46	1.46

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 356	1	1	1	1.22	1	1	207.20	1.22	1.22
Costar 357	1	1	1	1.22	1	0.84	174.10	1.02	1.02
Costar 358	1	1	1	1.22	0.85	1.2	211.40	1.24	1.24
Costar 359	1	1	1	1.22	0.85	1	176.20	1.04	1.04
Costar 360	1	1	1	1.22	0.85	0.84	148.00	0.87	0.87
Costar 361	1	1	1	1	1.19	1.2	242.60	1.43	1.43
Costar 362	1	1	1	1	1.19	1	202.20	1.19	1.19
Costar 363	1	1	1	1	1.19	0.84	169.80	1.00	1.00
Costar 364	1	1	1	1	1	1.2	203.90	1.20	1.20
Costar 365	1	1	1	1	1	1	169.90	1.00	1.00
Costar 366	1	1	1	1	1	0.84	142.70	0.84	0.84
Costar 367	1	1	1	1	0.85	1.2	173.30	1.02	1.02
Costar 368	1	1	1	1	0.85	1	144.40	0.85	0.85
Costar 369	1	1	1	1	0.85	0.84	121.30	0.71	0.71
Costar 370	1	1	1	0.81	1.19	1.2	196.50	1.16	1.16
Costar 371	1	1	1	0.81	1.19	1	163.70	0.96	0.96
Costar 372	1	1	1	0.81	1.19	0.84	137.50	0.81	0.81
Costar 373	1	1	1	0.81	1	1.2	165.10	0.97	0.97
Costar 374	1	1	1	0.81	1	1	137.60	0.81	0.81
Costar 375	1	1	1	0.81	1	0.84	115.60	0.68	0.68
Costar 376	1	1	1	0.81	0.85	1.2	140.40	0.83	0.83
Costar 377	1	1	1	0.81	0.85	1	117.00	0.69	0.69
Costar 378	1	1	1	0.81	0.85	0.84	98.20	0.58	0.58
Costar 379	1	1	0.81	1.22	1.19	1.2	239.70	1.41	1.41
Costar 380	1	1	0.81	1.22	1.19	1	199.80	1.18	1.18
Costar 381	1	1	0.81	1.22	1.19	0.84	167.80	0.99	0.99
Costar 382	1	1	0.81	1.22	1	1.2	201.40	1.19	1.19
Costar 383	1	1	0.81	1.22	1	1	167.90	0.99	0.99
Costar 384	1	1	0.81	1.22	1	0.84	141.00	0.83	0.83
Costar 385	1	1	0.81	1.22	0.85	1.2	171.20	1.01	1.01
Costar 386	1	1	0.81	1.22	0.85	1	142.70	0.84	0.84
Costar 387	1	1	0.81	1.22	0.85	0.84	119.90	0.71	0.71
Costar 388	1	1	0.81	1	1.19	1.2	196.50	1.16	1.16
Costar 389	1	1	0.81	1	1.19	1	163.70	0.96	0.96
Costar 390	1	1	0.81	1	1.19	0.84	137.50	0.81	0.81
Costar 391	1	1	0.81	1	1	1.2	165.10	0.97	0.97
Costar 392	1	1	0.81	1	1	1	137.60	0.81	0.81
Costar 393	1	1	0.81	1	1	0.84	115.60	0.68	0.68
Costar 394	1	1	0.81	1	0.85	1.2	140.40	0.83	0.83
Costar 395	1	1	0.81	1	0.85	1	117.00	0.69	0.69
Costar 396	1	1	0.81	1	0.85	0.84	98.20	0.58	0.58
Costar 397	1	1	0.81	0.81	1.19	1.2	159.20	0.94	0.94
Costar 398	1	1	0.81	0.81	1.19	1	132.60	0.78	0.78
Costar 399	1	1	0.81	0.81	1.19	0.84	111.40	0.66	0.66
Costar 400	1	1	0.81	0.81	1	1.2	133.70	0.79	0.79

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 401	1	1	0.81	0.81	1	1	111.50	0.66	0.66
Costar 402	1	1	0.81	0.81	1	0.84	93.60	0.55	0.55
Costar 403	1	1	0.81	0.81	0.85	1.2	113.70	0.67	0.67
Costar 404	1	1	0.81	0.81	0.85	1	94.70	0.56	0.56
Costar 405	1	1	0.81	0.81	0.85	0.84	79.60	0.47	0.47
Costar 406	1	0.76	1.29	1.22	1.19	1.2	290.20	1.71	1.71
Costar 407	1	0.76	1.29	1.22	1.19	1	241.80	1.42	1.42
Costar 408	1	0.76	1.29	1.22	1.19	0.84	203.10	1.20	1.20
Costar 409	1	0.76	1.29	1.22	1	1.2	243.80	1.43	1.44
Costar 410	1	0.76	1.29	1.22	1	1	203.20	1.20	1.20
Costar 411	1	0.76	1.29	1.22	1	0.84	170.70	1.00	1.00
Costar 412	1	0.76	1.29	1.22	0.85	1.2	207.30	1.22	1.22
Costar 413	1	0.76	1.29	1.22	0.85	1	172.70	1.02	1.02
Costar 414	1	0.76	1.29	1.22	0.85	0.84	145.10	0.85	0.85
Costar 415	1	0.76	1.29	1	1.19	1.2	237.80	1.40	1.40
Costar 416	1	0.76	1.29	1	1.19	1	198.20	1.17	1.17
Costar 417	1	0.76	1.29	1	1.19	0.84	166.50	0.98	0.98
Costar 418	1	0.76	1.29	1	1	1.2	199.90	1.18	1.18
Costar 419	1	0.76	1.29	1	1	1	166.50	0.98	0.98
Costar 420	1	0.76	1.29	1	1	0.84	139.90	0.82	0.82
Costar 421	1	0.76	1.29	1	0.85	1.2	169.90	1.00	1.00
Costar 422	1	0.76	1.29	1	0.85	1	141.60	0.83	0.83
Costar 423	1	0.76	1.29	1	0.85	0.84	118.90	0.70	0.70
Costar 424	1	0.76	1.29	0.81	1.19	1.2	192.60	1.13	1.13
Costar 425	1	0.76	1.29	0.81	1.19	1	160.50	0.94	0.95
Costar 426	1	0.76	1.29	0.81	1.19	0.84	134.80	0.79	0.79
Costar 427	1	0.76	1.29	0.81	1	1.2	161.90	0.95	0.95
Costar 428	1	0.76	1.29	0.81	1	1	134.90	0.79	0.79
Costar 429	1	0.76	1.29	0.81	1	0.84	113.30	0.67	0.67
Costar 430	1	0.76	1.29	0.81	0.85	1.2	137.60	0.81	0.81
Costar 431	1	0.76	1.29	0.81	0.85	1	114.70	0.68	0.68
Costar 432	1	0.76	1.29	0.81	0.85	0.84	96.30	0.57	0.57
Costar 433	1	0.76	1	1.22	1.19	1.2	224.90	1.32	1.32
Costar 434	1	0.76	1	1.22	1.19	1	187.40	1.10	1.10
Costar 435	1	0.76	1	1.22	1.19	0.84	157.40	0.93	0.93
Costar 436	1	0.76	1	1.22	1	1.2	189.00	1.11	1.11
Costar 437	1	0.76	1	1.22	1	1	157.50	0.93	0.93
Costar 438	1	0.76	1	1.22	1	0.84	132.30	0.78	0.78
Costar 439	1	0.76	1	1.22	0.85	1.2	160.70	0.95	0.95
Costar 440	1	0.76	1	1.22	0.85	1	133.90	0.79	0.79
Costar 441	1	0.76	1	1.22	0.85	0.84	112.50	0.66	0.66
Costar 442	1	0.76	1	1	1.19	1.2	184.40	1.09	1.09
Costar 443	1	0.76	1	1	1.19	1	153.60	0.90	0.90
Costar 444	1	0.76	1	1	1.19	0.84	129.10	0.76	0.76
Costar 445	1	0.76	1	1	1	1.2	154.90	0.91	0.91

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 446	1	0.76	1	1	1	1	129.10	0.76	0.76
Costar 447	1	0.76	1	1	1	0.84	108.40	0.64	0.64
Costar 448	1	0.76	1	1	0.85	1.2	131.70	0.78	0.78
Costar 449	1	0.76	1	1	0.85	1	109.70	0.65	0.65
Costar 450	1	0.76	1	1	0.85	0.84	92.20	0.54	0.54
Costar 451	1	0.76	1	0.81	1.19	1.2	149.30	0.88	0.88
Costar 452	1	0.76	1	0.81	1.19	1	124.40	0.73	0.73
Costar 453	1	0.76	1	0.81	1.19	0.84	104.50	0.62	0.62
Costar 454	1	0.76	1	0.81	1	1.2	125.50	0.74	0.74
Costar 455	1	0.76	1	0.81	1	1	104.60	0.62	0.62
Costar 456	1	0.76	1	0.81	1	0.84	87.80	0.52	0.52
Costar 457	1	0.76	1	0.81	0.85	1.2	106.70	0.63	0.63
Costar 458	1	0.76	1	0.81	0.85	1	88.90	0.52	0.52
Costar 459	1	0.76	1	0.81	0.85	0.84	74.70	0.44	0.44
Costar 460	1	0.76	0.81	1.22	1.19	1.2	182.20	1.07	1.07
Costar 461	1	0.76	0.81	1.22	1.19	1	151.80	0.89	0.89
Costar 462	1	0.76	0.81	1.22	1.19	0.84	127.50	0.75	0.75
Costar 463	1	0.76	0.81	1.22	1	1.2	153.10	0.90	0.90
Costar 464	1	0.76	0.81	1.22	1	1	127.60	0.75	0.75
Costar 465	1	0.76	0.81	1.22	1	0.84	107.20	0.63	0.63
Costar 466	1	0.76	0.81	1.22	0.85	1.2	130.10	0.77	0.77
Costar 467	1	0.76	0.81	1.22	0.85	1	108.40	0.64	0.64
Costar 468	1	0.76	0.81	1.22	0.85	0.84	91.10	0.54	0.54
Costar 469	1	0.76	0.81	1	1.19	1.2	149.30	0.88	0.88
Costar 470	1	0.76	0.81	1	1.19	1	124.40	0.73	0.73
Costar 471	1	0.76	0.81	1	1.19	0.84	104.50	0.62	0.62
Costar 472	1	0.76	0.81	1	1	1.2	125.50	0.74	0.74
Costar 473	1	0.76	0.81	1	1	1	104.60	0.62	0.62
Costar 474	1	0.76	0.81	1	1	0.84	87.80	0.52	0.52
Costar 475	1	0.76	0.81	1	0.85	1.2	106.70	0.63	0.63
Costar 476	1	0.76	0.81	1	0.85	1	88.90	0.52	0.52
Costar 477	1	0.76	0.81	1	0.85	0.84	74.70	0.44	0.44
Costar 478	1	0.76	0.81	0.81	1.19	1.2	121.00	0.71	0.71
Costar 479	1	0.76	0.81	0.81	1.19	1	100.80	0.59	0.59
Costar 480	1	0.76	0.81	0.81	1.19	0.84	84.70	0.50	0.50
Costar 481	1	0.76	0.81	0.81	1	1.2	101.60	0.60	0.60
Costar 482	1	0.76	0.81	0.81	1	1	84.70	0.50	0.50
Costar 483	1	0.76	0.81	0.81	1	0.84	71.20	0.42	0.42
Costar 484	1	0.76	0.81	0.81	0.85	1.2	86.40	0.51	0.51
Costar 485	1	0.76	0.81	0.81	0.85	1	72.00	0.42	0.42
Costar 486	1	0.76	0.81	0.81	0.85	0.84	60.50	0.36	0.36
Costar 487	0.71	1.34	1.29	1.22	1.19	1.2	363.20	2.14	2.14
Costar 488	0.71	1.34	1.29	1.22	1.19	1	302.70	1.78	1.78
Costar 489	0.71	1.34	1.29	1.22	1.19	0.84	254.30	1.50	1.50
Costar 490	0.71	1.34	1.29	1.22	1	1.2	305.20	1.80	1.80

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 491	0.71	1.34	1.29	1.22	1	1	254.40	1.50	1.50
Costar 492	0.71	1.34	1.29	1.22	1	0.84	213.70	1.26	1.26
Costar 493	0.71	1.34	1.29	1.22	0.85	1.2	259.40	1.53	1.53
Costar 494	0.71	1.34	1.29	1.22	0.85	1	216.20	1.27	1.27
Costar 495	0.71	1.34	1.29	1.22	0.85	0.84	181.60	1.07	1.07
Costar 496	0.71	1.34	1.29	1	1.19	1.2	297.70	1.75	1.75
Costar 497	0.71	1.34	1.29	1	1.19	1	248.10	1.46	1.46
Costar 498	0.71	1.34	1.29	1	1.19	0.84	208.40	1.23	1.23
Costar 499	0.71	1.34	1.29	1	1	1.2	250.20	1.47	1.47
Costar 500	0.71	1.34	1.29	1	1	1	208.50	1.23	1.23
Costar 501	0.71	1.34	1.29	1	1	0.84	175.10	1.03	1.03
Costar 502	0.71	1.34	1.29	1	0.85	1.2	212.70	1.25	1.25
Costar 503	0.71	1.34	1.29	1	0.85	1	177.20	1.04	1.04
Costar 504	0.71	1.34	1.29	1	0.85	0.84	148.90	0.88	0.88
Costar 505	0.71	1.34	1.29	0.81	1.19	1.2	241.20	1.42	1.42
Costar 506	0.71	1.34	1.29	0.81	1.19	1	201.00	1.18	1.18
Costar 507	0.71	1.34	1.29	0.81	1.19	0.84	168.80	0.99	0.99
Costar 508	0.71	1.34	1.29	0.81	1	1.2	202.70	1.19	1.19
Costar 509	0.71	1.34	1.29	0.81	1	1	168.90	0.99	0.99
Costar 510	0.71	1.34	1.29	0.81	1	0.84	141.90	0.84	0.84
Costar 511	0.71	1.34	1.29	0.81	0.85	1.2	172.30	1.01	1.01
Costar 512	0.71	1.34	1.29	0.81	0.85	1	143.50	0.84	0.85
Costar 513	0.71	1.34	1.29	0.81	0.85	0.84	120.60	0.71	0.71
Costar 514	0.71	1.34	1	1.22	1.19	1.2	281.60	1.66	1.66
Costar 515	0.71	1.34	1	1.22	1.19	1	234.60	1.38	1.38
Costar 516	0.71	1.34	1	1.22	1.19	0.84	197.10	1.16	1.16
Costar 517	0.71	1.34	1	1.22	1	1.2	236.60	1.39	1.39
Costar 518	0.71	1.34	1	1.22	1	1	197.20	1.16	1.16
Costar 519	0.71	1.34	1	1.22	1	0.84	165.60	0.97	0.97
Costar 520	0.71	1.34	1	1.22	0.85	1.2	201.10	1.18	1.18
Costar 521	0.71	1.34	1	1.22	0.85	1	167.60	0.99	0.99
Costar 522	0.71	1.34	1	1.22	0.85	0.84	140.80	0.83	0.83
Costar 523	0.71	1.34	1	1	1.19	1.2	230.80	1.36	1.36
Costar 524	0.71	1.34	1	1	1.19	1	192.30	1.13	1.13
Costar 525	0.71	1.34	1	1	1.19	0.84	161.60	0.95	0.95
Costar 526	0.71	1.34	1	1	1	1.2	193.90	1.14	1.14
Costar 527	0.71	1.34	1	1	1	1	161.60	0.95	0.95
Costar 528	0.71	1.34	1	1	1	0.84	135.80	0.80	0.80
Costar 529	0.71	1.34	1	1	0.85	1.2	164.90	0.97	0.97
Costar 530	0.71	1.34	1	1	0.85	1	137.40	0.81	0.81
Costar 531	0.71	1.34	1	1	0.85	0.84	115.40	0.68	0.68
Costar 532	0.71	1.34	1	0.81	1.19	1.2	186.90	1.10	1.10
Costar 533	0.71	1.34	1	0.81	1.19	1	155.80	0.92	0.92
Costar 534	0.71	1.34	1	0.81	1.19	0.84	130.90	0.77	0.77
Costar 535	0.71	1.34	1	0.81	1	1.2	157.10	0.92	0.92

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 536	0.71	1.34	1	0.81	1	1	130.90	0.77	0.77
Costar 537	0.71	1.34	1	0.81	1	0.84	110.00	0.65	0.65
Costar 538	0.71	1.34	1	0.81	0.85	1.2	133.50	0.79	0.79
Costar 539	0.71	1.34	1	0.81	0.85	1	111.30	0.66	0.66
Costar 540	0.71	1.34	1	0.81	0.85	0.84	93.50	0.55	0.55
Costar 541	0.71	1.34	0.81	1.22	1.19	1.2	228.10	1.34	1.34
Costar 542	0.71	1.34	0.81	1.22	1.19	1	190.10	1.12	1.12
Costar 543	0.71	1.34	0.81	1.22	1.19	0.84	159.60	0.94	0.94
Costar 544	0.71	1.34	0.81	1.22	1	1.2	191.70	1.13	1.13
Costar 545	0.71	1.34	0.81	1.22	1	1	159.70	0.94	0.94
Costar 546	0.71	1.34	0.81	1.22	1	0.84	134.20	0.79	0.79
Costar 547	0.71	1.34	0.81	1.22	0.85	1.2	162.90	0.96	0.96
Costar 548	0.71	1.34	0.81	1.22	0.85	1	135.80	0.80	0.80
Costar 549	0.71	1.34	0.81	1.22	0.85	0.84	114.00	0.67	0.67
Costar 550	0.71	1.34	0.81	1	1.19	1.2	186.90	1.10	1.10
Costar 551	0.71	1.34	0.81	1	1.19	1	155.80	0.92	0.92
Costar 552	0.71	1.34	0.81	1	1.19	0.84	130.90	0.77	0.77
Costar 553	0.71	1.34	0.81	1	1	1.2	157.10	0.92	0.92
Costar 554	0.71	1.34	0.81	1	1	1	130.90	0.77	0.77
Costar 555	0.71	1.34	0.81	1	1	0.84	110.00	0.65	0.65
Costar 556	0.71	1.34	0.81	1	0.85	1.2	133.50	0.79	0.79
Costar 557	0.71	1.34	0.81	1	0.85	1	111.30	0.66	0.66
Costar 558	0.71	1.34	0.81	1	0.85	0.84	93.50	0.55	0.55
Costar 559	0.71	1.34	0.81	0.81	1.19	1.2	151.40	0.89	0.89
Costar 560	0.71	1.34	0.81	0.81	1.19	1	126.20	0.74	0.74
Costar 561	0.71	1.34	0.81	0.81	1.19	0.84	106.00	0.62	0.62
Costar 562	0.71	1.34	0.81	0.81	1	1.2	127.20	0.75	0.75
Costar 563	0.71	1.34	0.81	0.81	1	1	106.00	0.62	0.62
Costar 564	0.71	1.34	0.81	0.81	1	0.84	89.10	0.52	0.52
Costar 565	0.71	1.34	0.81	0.81	0.85	1.2	108.20	0.64	0.64
Costar 566	0.71	1.34	0.81	0.81	0.85	1	90.10	0.53	0.53
Costar 567	0.71	1.34	0.81	0.81	0.85	0.84	75.70	0.45	0.45
Costar 568	0.71	1	1.29	1.22	1.19	1.2	271.10	1.60	1.60
Costar 569	0.71	1	1.29	1.22	1.19	1	225.90	1.33	1.33
Costar 570	0.71	1	1.29	1.22	1.19	0.84	189.70	1.12	1.12
Costar 571	0.71	1	1.29	1.22	1	1.2	227.80	1.34	1.34
Costar 572	0.71	1	1.29	1.22	1	1	189.80	1.12	1.12
Costar 573	0.71	1	1.29	1.22	1	0.84	159.40	0.94	0.94
Costar 574	0.71	1	1.29	1.22	0.85	1.2	193.60	1.14	1.14
Costar 575	0.71	1	1.29	1.22	0.85	1	161.30	0.95	0.95
Costar 576	0.71	1	1.29	1.22	0.85	0.84	135.50	0.80	0.80
Costar 577	0.71	1	1.29	1	1.19	1.2	222.20	1.31	1.31
Costar 578	0.71	1	1.29	1	1.19	1	185.20	1.09	1.09
Costar 579	0.71	1	1.29	1	1.19	0.84	155.50	0.92	0.92
Costar 580	0.71	1	1.29	1	1	1.2	186.70	1.10	1.10

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 581	0.71	1	1.29	1	1	1	155.60	0.92	0.92
Costar 582	0.71	1	1.29	1	1	0.84	130.70	0.77	0.77
Costar 583	0.71	1	1.29	1	0.85	1.2	158.70	0.93	0.93
Costar 584	0.71	1	1.29	1	0.85	1	132.30	0.78	0.78
Costar 585	0.71	1	1.29	1	0.85	0.84	111.10	0.65	0.65
Costar 586	0.71	1	1.29	0.81	1.19	1.2	180.00	1.06	1.06
Costar 587	0.71	1	1.29	0.81	1.19	1	150.00	0.88	0.88
Costar 588	0.71	1	1.29	0.81	1.19	0.84	126.00	0.74	0.74
Costar 589	0.71	1	1.29	0.81	1	1.2	151.20	0.89	0.89
Costar 590	0.71	1	1.29	0.81	1	1	126.00	0.74	0.74
Costar 591	0.71	1	1.29	0.81	1	0.84	105.90	0.62	0.62
Costar 592	0.71	1	1.29	0.81	0.85	1.2	128.50	0.76	0.76
Costar 593	0.71	1	1.29	0.81	0.85	1	107.10	0.63	0.63
Costar 594	0.71	1	1.29	0.81	0.85	0.84	90.00	0.53	0.53
Costar 595	0.71	1	1	1.22	1.19	1.2	210.10	1.24	1.24
Costar 596	0.71	1	1	1.22	1.19	1	175.10	1.03	1.03
Costar 597	0.71	1	1	1.22	1.19	0.84	147.10	0.87	0.87
Costar 598	0.71	1	1	1.22	1	1.2	176.60	1.04	1.04
Costar 599	0.71	1	1	1.22	1	1	147.10	0.87	0.87
Costar 600	0.71	1	1	1.22	1	0.84	123.60	0.73	0.73
Costar 601	0.71	1	1	1.22	0.85	1.2	150.10	0.88	0.88
Costar 602	0.71	1	1	1.22	0.85	1	125.10	0.74	0.74
Costar 603	0.71	1	1	1.22	0.85	0.84	105.10	0.62	0.62
Costar 604	0.71	1	1	1	1.19	1.2	172.20	1.01	1.01
Costar 605	0.71	1	1	1	1.19	1	143.50	0.84	0.84
Costar 606	0.71	1	1	1	1.19	0.84	120.60	0.71	0.71
Costar 607	0.71	1	1	1	1	1.2	144.70	0.85	0.85
Costar 608	0.71	1	1	1	1	1	120.60	0.71	0.71
Costar 609	0.71	1	1	1	1	0.84	101.30	0.60	0.60
Costar 610	0.71	1	1	1	0.85	1.2	123.00	0.72	0.72
Costar 611	0.71	1	1	1	0.85	1	102.50	0.60	0.60
Costar 612	0.71	1	1	1	0.85	0.84	86.10	0.51	0.51
Costar 613	0.71	1	1	0.81	1.19	1.2	139.50	0.82	0.82
Costar 614	0.71	1	1	0.81	1.19	1	116.30	0.68	0.68
Costar 615	0.71	1	1	0.81	1.19	0.84	97.70	0.58	0.57
Costar 616	0.71	1	1	0.81	1	1.2	117.20	0.69	0.69
Costar 617	0.71	1	1	0.81	1	1	97.70	0.58	0.58
Costar 618	0.71	1	1	0.81	1	0.84	82.10	0.48	0.48
Costar 619	0.71	1	1	0.81	0.85	1.2	99.60	0.59	0.59
Costar 620	0.71	1	1	0.81	0.85	1	83.00	0.49	0.49
Costar 621	0.71	1	1	0.81	0.85	0.84	69.80	0.41	0.41
Costar 622	0.71	1	0.81	1.22	1.19	1.2	170.20	1.00	1.00
Costar 623	0.71	1	0.81	1.22	1.19	1	141.80	0.83	0.83
Costar 624	0.71	1	0.81	1.22	1.19	0.84	119.10	0.70	0.70
Costar 625	0.71	1	0.81	1.22	1	1.2	143.00	0.84	0.84

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 626	0.71	1	0.81	1.22	1	1	119.20	0.70	0.70
Costar 627	0.71	1	0.81	1.22	1	0.84	100.10	0.59	0.59
Costar 628	0.71	1	0.81	1.22	0.85	1.2	121.60	0.72	0.72
Costar 629	0.71	1	0.81	1.22	0.85	1	101.30	0.60	0.60
Costar 630	0.71	1	0.81	1.22	0.85	0.84	85.10	0.50	0.50
Costar 631	0.71	1	0.81	1	1.19	1.2	139.50	0.82	0.82
Costar 632	0.71	1	0.81	1	1.19	1	116.30	0.68	0.68
Costar 633	0.71	1	0.81	1	1.19	0.84	97.70	0.58	0.57
Costar 634	0.71	1	0.81	1	1	1.2	117.20	0.69	0.69
Costar 635	0.71	1	0.81	1	1	1	97.70	0.58	0.58
Costar 636	0.71	1	0.81	1	1	0.84	82.10	0.48	0.48
Costar 637	0.71	1	0.81	1	0.85	1.2	99.60	0.59	0.59
Costar 638	0.71	1	0.81	1	0.85	1	83.00	0.49	0.49
Costar 639	0.71	1	0.81	1	0.85	0.84	69.80	0.41	0.41
Costar 640	0.71	1	0.81	0.81	1.19	1.2	113.00	0.67	0.67
Costar 641	0.71	1	0.81	0.81	1.19	1	94.20	0.55	0.55
Costar 642	0.71	1	0.81	0.81	1.19	0.84	79.10	0.47	0.47
Costar 643	0.71	1	0.81	0.81	1	1.2	95.00	0.56	0.56
Costar 644	0.71	1	0.81	0.81	1	1	79.10	0.47	0.47
Costar 645	0.71	1	0.81	0.81	1	0.84	66.50	0.39	0.39
Costar 646	0.71	1	0.81	0.81	0.85	1.2	80.70	0.47	0.48
Costar 647	0.71	1	0.81	0.81	0.85	1	67.30	0.40	0.40
Costar 648	0.71	1	0.81	0.81	0.85	0.84	56.50	0.33	0.33
Costar 649	0.71	0.76	1.29	1.22	1.19	1.2	206.00	1.21	1.21
Costar 650	0.71	0.76	1.29	1.22	1.19	1	171.70	1.01	1.01
Costar 651	0.71	0.76	1.29	1.22	1.19	0.84	144.20	0.85	0.85
Costar 652	0.71	0.76	1.29	1.22	1	1.2	173.10	1.02	1.02
Costar 653	0.71	0.76	1.29	1.22	1	1	144.30	0.85	0.85
Costar 654	0.71	0.76	1.29	1.22	1	0.84	121.20	0.71	0.71
Costar 655	0.71	0.76	1.29	1.22	0.85	1.2	147.10	0.87	0.87
Costar 656	0.71	0.76	1.29	1.22	0.85	1	122.60	0.72	0.72
Costar 657	0.71	0.76	1.29	1.22	0.85	0.84	103.00	0.61	0.61
Costar 658	0.71	0.76	1.29	1	1.19	1.2	168.90	0.99	0.99
Costar 659	0.71	0.76	1.29	1	1.19	1	140.70	0.83	0.83
Costar 660	0.71	0.76	1.29	1	1.19	0.84	118.20	0.70	0.70
Costar 661	0.71	0.76	1.29	1	1	1.2	141.90	0.84	0.84
Costar 662	0.71	0.76	1.29	1	1	1	118.20	0.70	0.70
Costar 663	0.71	0.76	1.29	1	1	0.84	99.30	0.58	0.58
Costar 664	0.71	0.76	1.29	1	0.85	1.2	120.60	0.71	0.71
Costar 665	0.71	0.76	1.29	1	0.85	1	100.50	0.59	0.59
Costar 666	0.71	0.76	1.29	1	0.85	0.84	84.40	0.50	0.50
Costar 667	0.71	0.76	1.29	0.81	1.19	1.2	136.80	0.81	0.81
Costar 668	0.71	0.76	1.29	0.81	1.19	1	114.00	0.67	0.67
Costar 669	0.71	0.76	1.29	0.81	1.19	0.84	95.70	0.56	0.56
Costar 670	0.71	0.76	1.29	0.81	1	1.2	114.90	0.68	0.68

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 671	0.71	0.76	1.29	0.81	1	1	95.80	0.56	0.56
Costar 672	0.71	0.76	1.29	0.81	1	0.84	80.50	0.47	0.47
Costar 673	0.71	0.76	1.29	0.81	0.85	1.2	97.70	0.58	0.58
Costar 674	0.71	0.76	1.29	0.81	0.85	1	81.40	0.48	0.48
Costar 675	0.71	0.76	1.29	0.81	0.85	0.84	68.40	0.40	0.40
Costar 676	0.71	0.76	1	1.22	1.19	1.2	159.70	0.94	0.94
Costar 677	0.71	0.76	1	1.22	1.19	1	133.10	0.78	0.78
Costar 678	0.71	0.76	1	1.22	1.19	0.84	111.80	0.66	0.66
Costar 679	0.71	0.76	1	1.22	1	1.2	134.20	0.79	0.79
Costar 680	0.71	0.76	1	1.22	1	1	111.80	0.66	0.66
Costar 681	0.71	0.76	1	1.22	1	0.84	93.90	0.55	0.55
Costar 682	0.71	0.76	1	1.22	0.85	1.2	114.10	0.67	0.67
Costar 683	0.71	0.76	1	1.22	0.85	1	95.10	0.56	0.56
Costar 684	0.71	0.76	1	1.22	0.85	0.84	79.80	0.47	0.47
Costar 685	0.71	0.76	1	1	1.19	1.2	130.90	0.77	0.77
Costar 686	0.71	0.76	1	1	1.19	1	109.10	0.64	0.64
Costar 687	0.71	0.76	1	1	1.19	0.84	91.60	0.54	0.54
Costar 688	0.71	0.76	1	1	1	1.2	110.00	0.65	0.65
Costar 689	0.71	0.76	1	1	1	1	91.70	0.54	0.54
Costar 690	0.71	0.76	1	1	1	0.84	77.00	0.45	0.45
Costar 691	0.71	0.76	1	1	0.85	1.2	93.50	0.55	0.55
Costar 692	0.71	0.76	1	1	0.85	1	77.90	0.46	0.46
Costar 693	0.71	0.76	1	1	0.85	0.84	65.40	0.38	0.39
Costar 694	0.71	0.76	1	0.81	1.19	1.2	106.00	0.62	0.62
Costar 695	0.71	0.76	1	0.81	1.19	1	88.40	0.52	0.52
Costar 696	0.71	0.76	1	0.81	1.19	0.84	74.20	0.44	0.44
Costar 697	0.71	0.76	1	0.81	1	1.2	89.10	0.52	0.52
Costar 698	0.71	0.76	1	0.81	1	1	74.20	0.44	0.44
Costar 699	0.71	0.76	1	0.81	1	0.84	62.40	0.37	0.37
Costar 700	0.71	0.76	1	0.81	0.85	1.2	75.70	0.45	0.45
Costar 701	0.71	0.76	1	0.81	0.85	1	63.10	0.37	0.37
Costar 702	0.71	0.76	1	0.81	0.85	0.84	53.00	0.31	0.31
Costar 703	0.71	0.76	0.81	1.22	1.19	1.2	129.40	0.76	0.76
Costar 704	0.71	0.76	0.81	1.22	1.19	1	107.80	0.63	0.63
Costar 705	0.71	0.76	0.81	1.22	1.19	0.84	90.50	0.53	0.53
Costar 706	0.71	0.76	0.81	1.22	1	1.2	108.70	0.64	0.64
Costar 707	0.71	0.76	0.81	1.22	1	1	90.60	0.53	0.53
Costar 708	0.71	0.76	0.81	1.22	1	0.84	76.10	0.45	0.45
Costar 709	0.71	0.76	0.81	1.22	0.85	1.2	92.40	0.54	0.54
Costar 710	0.71	0.76	0.81	1.22	0.85	1	77.00	0.45	0.45
Costar 711	0.71	0.76	0.81	1.22	0.85	0.84	64.70	0.38	0.38
Costar 712	0.71	0.76	0.81	1	1.19	1.2	106.00	0.62	0.62
Costar 713	0.71	0.76	0.81	1	1.19	1	88.40	0.52	0.52
Costar 714	0.71	0.76	0.81	1	1.19	0.84	74.20	0.44	0.44
Costar 715	0.71	0.76	0.81	1	1	1.2	89.10	0.52	0.52

Run	ACAP	PCAP	PCON	APEX	PLEX	LTEX	Effort Months	Change from Nominal	Product of parameter value
Costar 716	0.71	0.76	0.81	1	1	1	74.20	0.44	0.44
Costar 717	0.71	0.76	0.81	1	1	0.84	62.40	0.37	0.37
Costar 718	0.71	0.76	0.81	1	0.85	1.2	75.70	0.45	0.45
Costar 719	0.71	0.76	0.81	1	0.85	1	63.10	0.37	0.37
Costar 720	0.71	0.76	0.81	1	0.85	0.84	53.00	0.31	0.31
Costar 721	0.71	0.76	0.81	0.81	1.19	1.2	85.90	0.51	0.51
Costar 722	0.71	0.76	0.81	0.81	1.19	1	71.60	0.42	0.42
Costar 723	0.71	0.76	0.81	0.81	1.19	0.84	60.10	0.35	0.35
Costar 724	0.71	0.76	0.81	0.81	1	1.2	72.20	0.42	0.42
Costar 725	0.71	0.76	0.81	0.81	1	1	60.10	0.35	0.35
Costar 726	0.71	0.76	0.81	0.81	1	0.84	50.50	0.30	0.30
Costar 727	0.71	0.76	0.81	0.81	0.85	1.2	61.30	0.36	0.36
Costar 728	0.71	0.76	0.81	0.81	0.85	1	51.10	0.30	0.30
Costar 729	0.71	0.76	0.81	0.81	0.85	0.84	42.90	0.25	0.25

Appendix 8 SEER-SEM Data Table

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 1	VLo	VLo-	VLo	VLo-	VLo-	VLo-	1397.34	3.87
SEER 2	VLo	VLo-	VLo	VLo-	VLo-	Nom	1295.92	3.59
SEER 3	VLo	VLo-	VLo	VLo-	VLo-	EHi	1267.35	3.51
SEER 4	VLo	VLo-	VLo	VLo-	Nom	VLo-	1219.64	3.38
SEER 5	VLo	VLo-	VLo	VLo-	Nom	Nom	1131.12	3.13
SEER 6	VLo	VLo-	VLo	VLo-	Nom	EHi	1106.18	3.06
SEER 7	VLo	VLo-	VLo	VLo-	EHi	VLo-	1169.93	3.24
SEER 8	VLo	VLo-	VLo	VLo-	EHi	Nom	1085.01	3.00
SEER 9	VLo	VLo-	VLo	VLo-	EHi	EHi	1061.09	2.94
SEER 10	VLo	VLo-	VLo	Nom	VLo-	VLo-	1141.55	3.16
SEER 11	VLo	VLo-	VLo	Nom	VLo-	Nom	1058.7	2.93
SEER 12	VLo	VLo-	VLo	Nom	VLo-	EHi	1035.36	2.87
SEER 13	VLo	VLo-	VLo	Nom	Nom	VLo-	996.38	2.76
SEER 14	VLo	VLo-	VLo	Nom	Nom	Nom	924.07	2.56
SEER 15	VLo	VLo-	VLo	Nom	Nom	EHi	903.69	2.50
SEER 16	VLo	VLo-	VLo	Nom	EHi	VLo-	955.77	2.65
SEER 17	VLo	VLo-	VLo	Nom	EHi	Nom	886.4	2.45
SEER 18	VLo	VLo-	VLo	Nom	EHi	EHi	866.86	2.40
SEER 19	VLo	VLo-	VLo	EHi	VLo-	VLo-	1128.39	3.12
SEER 20	VLo	VLo-	VLo	EHi	VLo-	Nom	1046.49	2.90
SEER 21	VLo	VLo-	VLo	EHi	VLo-	EHi	1023.42	2.83
SEER 22	VLo	VLo-	VLo	EHi	Nom	VLo-	984.9	2.73
SEER 23	VLo	VLo-	VLo	EHi	Nom	Nom	913.42	2.53
SEER 24	VLo	VLo-	VLo	EHi	Nom	EHi	893.28	2.47
SEER 25	VLo	VLo-	VLo	EHi	EHi	VLo-	944.75	2.61
SEER 26	VLo	VLo-	VLo	EHi	EHi	Nom	876.18	2.43
SEER 27	VLo	VLo-	VLo	EHi	EHi	EHi	856.86	2.37
SEER 28	VLo	VLo-	Nom	VLo-	VLo-	VLo-	1022.64	2.83
SEER 29	VLo	VLo-	Nom	VLo-	VLo-	Nom	948.42	2.63
SEER 30	VLo	VLo-	Nom	VLo-	VLo-	EHi	927.51	2.57
SEER 31	VLo	VLo-	Nom	VLo-	Nom	VLo-	892.6	2.47
SEER 32	VLo	VLo-	Nom	VLo-	Nom	Nom	827.81	2.29
SEER 33	VLo	VLo-	Nom	VLo-	Nom	EHi	809.56	2.24
SEER 34	VLo	VLo-	Nom	VLo-	EHi	VLo-	856.21	2.37
SEER 35	VLo	VLo-	Nom	VLo-	EHi	Nom	794.07	2.20
SEER 36	VLo	VLo-	Nom	VLo-	EHi	EHi	776.56	2.15
SEER 37	VLo	VLo-	Nom	Nom	VLo-	VLo-	835.45	2.31
SEER 38	VLo	VLo-	Nom	Nom	VLo-	Nom	774.81	2.14
SEER 39	VLo	VLo-	Nom	Nom	VLo-	EHi	757.73	2.10
SEER 40	VLo	VLo-	Nom	Nom	Nom	VLo-	729.2	2.02
SEER 41	VLo	VLo-	Nom	Nom	Nom	Nom	676.28	1.87
SEER 42	VLo	VLo-	Nom	Nom	Nom	EHi	661.37	1.83
SEER 43	VLo	VLo-	Nom	Nom	EHi	VLo-	699.48	1.94
SEER 44	VLo	VLo-	Nom	Nom	EHi	Nom	648.71	1.80
SEER 45	VLo	VLo-	Nom	Nom	EHi	EHi	634.41	1.76
SEER 46	VLo	VLo-	Nom	EHi	VLo-	VLo-	825.82	2.29
SEER 47	VLo	VLo-	Nom	EHi	VLo-	Nom	765.88	2.12
SEER 48	VLo	VLo-	Nom	EHi	VLo-	EHi	748.99	2.07
SEER 49	VLo	VLo-	Nom	EHi	Nom	VLo-	720.8	2.00
SEER 50	VLo	VLo-	Nom	EHi	Nom	Nom	668.48	1.85
SEER 51	VLo	VLo-	Nom	EHi	Nom	EHi	653.75	1.81
SEER 52	VLo	VLo-	Nom	EHi	EHi	VLo-	691.42	1.91
SEER 53	VLo	VLo-	Nom	EHi	EHi	Nom	641.23	1.77
SEER 54	VLo	VLo-	Nom	EHi	EHi	EHi	627.1	1.74
SEER 55	VLo	VLo-	VHi	VLo-	VLo-	VLo-	744.42	2.06
SEER 56	VLo	VLo-	VHi	VLo-	VLo-	Nom	690.39	1.91
SEER 57	VLo	VLo-	VHi	VLo-	VLo-	EHi	675.17	1.87
SEER 58	VLo	VLo-	VHi	VLo-	Nom	VLo-	649.76	1.80
SEER 59	VLo	VLo-	VHi	VLo-	Nom	Nom	602.6	1.67
SEER 60	VLo	VLo-	VHi	VLo-	Nom	EHi	589.31	1.63
SEER 61	VLo	VLo-	VHi	VLo-	EHi	VLo-	623.27	1.73
SEER 62	VLo	VLo-	VHi	VLo-	EHi	Nom	578.03	1.60
SEER 63	VLo	VLo-	VHi	VLo-	EHi	EHi	565.29	1.56
SEER 64	VLo	VLo-	VHi	Nom	VLo-	VLo-	608.15	1.68
SEER 65	VLo	VLo-	VHi	Nom	VLo-	Nom	564.01	1.56

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 66	VLo	VLo-	VHi	Nom	VLo-	EHi	551.58	1.53
SEER 67	VLo	VLo-	VHi	Nom	Nom	VLo-	530.82	1.47
SEER 68	VLo	VLo-	VHi	Nom	Nom	Nom	492.29	1.36
SEER 69	VLo	VLo-	VHi	Nom	Nom	EHi	481.44	1.33
SEER 70	VLo	VLo-	VHi	Nom	EHi	VLo-	509.18	1.41
SEER 71	VLo	VLo-	VHi	Nom	EHi	Nom	472.22	1.31
SEER 72	VLo	VLo-	VHi	Nom	EHi	EHi	461.81	1.28
SEER 73	VLo	VLo-	VHi	EHi	VLo-	VLo-	601.14	1.66
SEER 74	VLo	VLo-	VHi	EHi	VLo-	Nom	557.51	1.54
SEER 75	VLo	VLo-	VHi	EHi	VLo-	EHi	545.22	1.51
SEER 76	VLo	VLo-	VHi	EHi	Nom	VLo-	524.7	1.45
SEER 77	VLo	VLo-	VHi	EHi	Nom	Nom	486.62	1.35
SEER 78	VLo	VLo-	VHi	EHi	Nom	EHi	475.89	1.32
SEER 79	VLo	VLo-	VHi	EHi	EHi	VLo-	503.31	1.39
SEER 80	VLo	VLo-	VHi	EHi	EHi	Nom	466.78	1.29
SEER 81	VLo	VLo-	VHi	EHi	EHi	EHi	456.49	1.26
SEER 82	VLo	Nom	VLo	VLo-	VLo-	VLo-	1045.61	2.89
SEER 83	VLo	Nom	VLo	VLo-	VLo-	Nom	969.71	2.68
SEER 84	VLo	Nom	VLo	VLo-	VLo-	EHi	948.34	2.62
SEER 85	VLo	Nom	VLo	VLo-	Nom	VLo-	912.64	2.53
SEER 86	VLo	Nom	VLo	VLo-	Nom	Nom	846.4	2.34
SEER 87	VLo	Nom	VLo	VLo-	Nom	EHi	827.74	2.29
SEER 88	VLo	Nom	VLo	VLo-	EHi	VLo-	875.44	2.42
SEER 89	VLo	Nom	VLo	VLo-	EHi	Nom	811.9	2.25
SEER 90	VLo	Nom	VLo	VLo-	EHi	EHi	794	2.20
SEER 91	VLo	Nom	VLo	Nom	VLo-	VLo-	854.2	2.36
SEER 92	VLo	Nom	VLo	Nom	VLo-	Nom	792.2	2.19
SEER 93	VLo	Nom	VLo	Nom	VLo-	EHi	774.74	2.14
SEER 94	VLo	Nom	VLo	Nom	Nom	VLo-	745.58	2.06
SEER 95	VLo	Nom	VLo	Nom	Nom	Nom	691.46	1.91
SEER 96	VLo	Nom	VLo	Nom	Nom	EHi	676.22	1.87
SEER 97	VLo	Nom	VLo	Nom	EHi	VLo-	715.19	1.98
SEER 98	VLo	Nom	VLo	Nom	EHi	Nom	663.28	1.84
SEER 99	VLo	Nom	VLo	Nom	EHi	EHi	648.65	1.80
SEER 100	VLo	Nom	VLo	EHi	VLo-	VLo-	844.36	2.34
SEER 101	VLo	Nom	VLo	EHi	VLo-	Nom	783.07	2.17
SEER 102	VLo	Nom	VLo	EHi	VLo-	EHi	765.81	2.12
SEER 103	VLo	Nom	VLo	EHi	Nom	VLo-	736.98	2.04
SEER 104	VLo	Nom	VLo	EHi	Nom	Nom	683.49	1.89
SEER 105	VLo	Nom	VLo	EHi	Nom	EHi	668.42	1.85
SEER 106	VLo	Nom	VLo	EHi	EHi	VLo-	706.94	1.96
SEER 107	VLo	Nom	VLo	EHi	EHi	Nom	655.63	1.81
SEER 108	VLo	Nom	VLo	EHi	EHi	EHi	641.18	1.77
SEER 109	VLo	Nom	Nom	VLo-	VLo-	VLo-	765.23	2.12
SEER 110	VLo	Nom	Nom	VLo-	VLo-	Nom	709.69	1.96
SEER 111	VLo	Nom	Nom	VLo-	VLo-	EHi	694.04	1.92
SEER 112	VLo	Nom	Nom	VLo-	Nom	VLo-	667.92	1.85
SEER 113	VLo	Nom	Nom	VLo-	Nom	Nom	619.44	1.71
SEER 114	VLo	Nom	Nom	VLo-	Nom	EHi	605.78	1.68
SEER 115	VLo	Nom	Nom	VLo-	EHi	VLo-	640.69	1.77
SEER 116	VLo	Nom	Nom	VLo-	EHi	Nom	594.19	1.64
SEER 117	VLo	Nom	Nom	VLo-	EHi	EHi	581.09	1.61
SEER 118	VLo	Nom	Nom	Nom	VLo-	VLo-	625.15	1.73
SEER 119	VLo	Nom	Nom	Nom	VLo-	Nom	579.78	1.60
SEER 120	VLo	Nom	Nom	Nom	VLo-	EHi	566.99	1.57
SEER 121	VLo	Nom	Nom	Nom	Nom	VLo-	545.65	1.51
SEER 122	VLo	Nom	Nom	Nom	Nom	Nom	506.05	1.40
SEER 123	VLo	Nom	Nom	Nom	Nom	EHi	494.89	1.37
SEER 124	VLo	Nom	Nom	Nom	EHi	VLo-	523.41	1.45
SEER 125	VLo	Nom	Nom	Nom	EHi	Nom	485.42	1.34
SEER 126	VLo	Nom	Nom	Nom	EHi	EHi	474.72	1.31
SEER 127	VLo	Nom	Nom	EHi	VLo-	VLo-	617.94	1.71
SEER 128	VLo	Nom	Nom	EHi	VLo-	Nom	573.09	1.59
SEER 129	VLo	Nom	Nom	EHi	VLo-	EHi	560.46	1.55
SEER 130	VLo	Nom	Nom	EHi	Nom	VLo-	539.36	1.49
SEER 131	VLo	Nom	Nom	EHi	Nom	Nom	500.22	1.38
SEER 132	VLo	Nom	Nom	EHi	Nom	EHi	489.19	1.35
SEER 133	VLo	Nom	Nom	EHi	EHi	VLo-	517.38	1.43
SEER 134	VLo	Nom	Nom	EHi	EHi	Nom	479.82	1.33
SEER 135	VLo	Nom	Nom	EHi	EHi	EHi	469.25	1.30

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 136	VLo	Nom	VHi	VLo-	VLo-	VLo-	557.04	1.54
SEER 137	VLo	Nom	VHi	VLo-	VLo-	Nom	516.61	1.43
SEER 138	VLo	Nom	VHi	VLo-	VLo-	EHi	505.22	1.40
SEER 139	VLo	Nom	VHi	VLo-	Nom	VLo-	486.2	1.35
SEER 140	VLo	Nom	VHi	VLo-	Nom	Nom	450.91	1.25
SEER 141	VLo	Nom	VHi	VLo-	Nom	EHi	440.97	1.22
SEER 142	VLo	Nom	VHi	VLo-	EHi	VLo-	466.38	1.29
SEER 143	VLo	Nom	VHi	VLo-	EHi	Nom	432.53	1.20
SEER 144	VLo	Nom	VHi	VLo-	EHi	EHi	423	1.17
SEER 145	VLo	Nom	VHi	Nom	VLo-	VLo-	455.07	1.26
SEER 146	VLo	Nom	VHi	Nom	VLo-	Nom	422.04	1.17
SEER 147	VLo	Nom	VHi	Nom	VLo-	EHi	412.74	1.14
SEER 148	VLo	Nom	VHi	Nom	Nom	VLo-	397.2	1.10
SEER 149	VLo	Nom	VHi	Nom	Nom	Nom	368.37	1.02
SEER 150	VLo	Nom	VHi	Nom	Nom	EHi	360.25	1.00
SEER 151	VLo	Nom	VHi	Nom	EHi	VLo-	381.01	1.05
SEER 152	VLo	Nom	VHi	Nom	EHi	Nom	353.36	0.98
SEER 153	VLo	Nom	VHi	Nom	EHi	EHi	345.57	0.96
SEER 154	VLo	Nom	VHi	EHi	VLo-	VLo-	449.83	1.25
SEER 155	VLo	Nom	VHi	EHi	VLo-	Nom	417.18	1.15
SEER 156	VLo	Nom	VHi	EHi	VLo-	EHi	407.98	1.13
SEER 157	VLo	Nom	VHi	EHi	Nom	VLo-	392.62	1.09
SEER 158	VLo	Nom	VHi	EHi	Nom	Nom	364.13	1.01
SEER 159	VLo	Nom	VHi	EHi	Nom	EHi	356.1	0.99
SEER 160	VLo	Nom	VHi	EHi	EHi	VLo-	376.62	1.04
SEER 161	VLo	Nom	VHi	EHi	EHi	Nom	349.28	0.97
SEER 162	VLo	Nom	VHi	EHi	EHi	EHi	341.58	0.95
SEER 163	VLo	VHi	VLo	VLo-	VLo-	VLo-	935.01	2.59
SEER 164	VLo	VHi	VLo	VLo-	VLo-	Nom	867.15	2.40
SEER 165	VLo	VHi	VLo	VLo-	VLo-	EHi	848.03	2.35
SEER 166	VLo	VHi	VLo	VLo-	Nom	VLo-	816.11	2.26
SEER 167	VLo	VHi	VLo	VLo-	Nom	Nom	756.88	2.09
SEER 168	VLo	VHi	VLo	VLo-	Nom	EHi	740.19	2.05
SEER 169	VLo	VHi	VLo	VLo-	EHi	VLo-	782.84	2.17
SEER 170	VLo	VHi	VLo	VLo-	EHi	Nom	726.02	2.01
SEER 171	VLo	VHi	VLo	VLo-	EHi	EHi	710.02	1.97
SEER 172	VLo	VHi	VLo	Nom	VLo-	VLo-	763.85	2.11
SEER 173	VLo	VHi	VLo	Nom	VLo-	Nom	708.41	1.96
SEER 174	VLo	VHi	VLo	Nom	VLo-	EHi	692.8	1.92
SEER 175	VLo	VHi	VLo	Nom	Nom	VLo-	666.72	1.85
SEER 176	VLo	VHi	VLo	Nom	Nom	Nom	618.33	1.71
SEER 177	VLo	VHi	VLo	Nom	Nom	EHi	604.7	1.67
SEER 178	VLo	VHi	VLo	Nom	EHi	VLo-	639.54	1.77
SEER 179	VLo	VHi	VLo	Nom	EHi	Nom	593.12	1.64
SEER 180	VLo	VHi	VLo	Nom	EHi	EHi	580.05	1.61
SEER 181	VLo	VHi	VLo	EHi	VLo-	VLo-	755.05	2.09
SEER 182	VLo	VHi	VLo	EHi	VLo-	Nom	700.25	1.94
SEER 183	VLo	VHi	VLo	EHi	VLo-	EHi	684.81	1.90
SEER 184	VLo	VHi	VLo	EHi	Nom	VLo-	659.03	1.82
SEER 185	VLo	VHi	VLo	EHi	Nom	Nom	611.2	1.69
SEER 186	VLo	VHi	VLo	EHi	Nom	EHi	597.73	1.65
SEER 187	VLo	VHi	VLo	EHi	EHi	VLo-	632.17	1.75
SEER 188	VLo	VHi	VLo	EHi	EHi	Nom	586.29	1.62
SEER 189	VLo	VHi	VLo	EHi	EHi	EHi	573.36	1.59
SEER 190	VLo	VHi	Nom	VLo-	VLo-	VLo-	684.29	1.89
SEER 191	VLo	VHi	Nom	VLo-	VLo-	Nom	634.62	1.76
SEER 192	VLo	VHi	Nom	VLo-	VLo-	EHi	620.63	1.72
SEER 193	VLo	VHi	Nom	VLo-	Nom	VLo-	597.27	1.65
SEER 194	VLo	VHi	Nom	VLo-	Nom	Nom	553.92	1.53
SEER 195	VLo	VHi	Nom	VLo-	Nom	EHi	541.71	1.50
SEER 196	VLo	VHi	Nom	VLo-	EHi	VLo-	572.92	1.59
SEER 197	VLo	VHi	Nom	VLo-	EHi	Nom	531.34	1.47
SEER 198	VLo	VHi	Nom	VLo-	EHi	EHi	519.63	1.44
SEER 199	VLo	VHi	Nom	Nom	VLo-	VLo-	559.03	1.55
SEER 200	VLo	VHi	Nom	Nom	VLo-	Nom	518.45	1.43
SEER 201	VLo	VHi	Nom	Nom	VLo-	EHi	507.02	1.40
SEER 202	VLo	VHi	Nom	Nom	Nom	VLo-	487.94	1.35
SEER 203	VLo	VHi	Nom	Nom	Nom	Nom	452.52	1.25
SEER 204	VLo	VHi	Nom	Nom	Nom	EHi	442.55	1.22
SEER 205	VLo	VHi	Nom	Nom	EHi	VLo-	468.05	1.30

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 206	VLo	VHi	Nom	Nom	EHi	Nom	434.08	1.20
SEER 207	VLo	VHi	Nom	Nom	EHi	EHi	424.51	1.17
SEER 208	VLo	VHi	Nom	EHi	VLo-	VLo-	552.58	1.53
SEER 209	VLo	VHi	Nom	EHi	VLo-	Nom	512.48	1.42
SEER 210	VLo	VHi	Nom	EHi	VLo-	EHi	501.18	1.39
SEER 211	VLo	VHi	Nom	EHi	Nom	VLo-	482.31	1.33
SEER 212	VLo	VHi	Nom	EHi	Nom	Nom	447.31	1.24
SEER 213	VLo	VHi	Nom	EHi	Nom	EHi	437.45	1.21
SEER 214	VLo	VHi	Nom	EHi	EHi	VLo-	462.65	1.28
SEER 215	VLo	VHi	Nom	EHi	EHi	Nom	429.07	1.19
SEER 216	VLo	VHi	Nom	EHi	EHi	EHi	419.61	1.16
SEER 217	VLo	VHi	VHi	VLo-	VLo-	VLo-	498.12	1.38
SEER 218	VLo	VHi	VHi	VLo-	VLo-	Nom	461.97	1.28
SEER 219	VLo	VHi	VHi	VLo-	VLo-	EHi	451.78	1.25
SEER 220	VLo	VHi	VHi	VLo-	Nom	VLo-	434.78	1.20
SEER 221	VLo	VHi	VHi	VLo-	Nom	Nom	403.22	1.12
SEER 222	VLo	VHi	VHi	VLo-	Nom	EHi	394.33	1.09
SEER 223	VLo	VHi	VHi	VLo-	EHi	VLo-	417.05	1.15
SEER 224	VLo	VHi	VHi	VLo-	EHi	Nom	386.78	1.07
SEER 225	VLo	VHi	VHi	VLo-	EHi	EHi	378.26	1.05
SEER 226	VLo	VHi	VHi	Nom	VLo-	VLo-	406.94	1.13
SEER 227	VLo	VHi	VHi	Nom	VLo-	Nom	377.4	1.04
SEER 228	VLo	VHi	VHi	Nom	VLo-	EHi	369.08	1.02
SEER 229	VLo	VHi	VHi	Nom	Nom	VLo-	355.19	0.98
SEER 230	VLo	VHi	VHi	Nom	Nom	Nom	329.41	0.91
SEER 231	VLo	VHi	VHi	Nom	Nom	EHi	322.15	0.89
SEER 232	VLo	VHi	VHi	Nom	EHi	VLo-	340.71	0.94
SEER 233	VLo	VHi	VHi	Nom	EHi	Nom	315.98	0.87
SEER 234	VLo	VHi	VHi	Nom	EHi	EHi	309.02	0.86
SEER 235	VLo	VHi	VHi	EHi	VLo-	VLo-	402.25	1.11
SEER 236	VLo	VHi	VHi	EHi	VLo-	Nom	373.05	1.03
SEER 237	VLo	VHi	VHi	EHi	VLo-	EHi	364.83	1.01
SEER 238	VLo	VHi	VHi	EHi	Nom	VLo-	351.1	0.97
SEER 239	VLo	VHi	VHi	EHi	Nom	Nom	325.61	0.90
SEER 240	VLo	VHi	VHi	EHi	Nom	EHi	318.43	0.88
SEER 241	VLo	VHi	VHi	EHi	EHi	VLo-	336.78	0.93
SEER 242	VLo	VHi	VHi	EHi	EHi	Nom	312.34	0.86
SEER 243	VLo	VHi	VHi	EHi	EHi	EHi	305.45	0.85
SEER 244	Nom	VLo-	VLo	VLo-	VLo-	VLo-	997.66	2.76
SEER 245	Nom	VLo-	VLo	VLo-	VLo-	Nom	925.25	2.56
SEER 246	Nom	VLo-	VLo	VLo-	VLo-	EHi	904.85	2.50
SEER 247	Nom	VLo-	VLo	VLo-	Nom	VLo-	870.79	2.41
SEER 248	Nom	VLo-	VLo	VLo-	Nom	Nom	807.59	2.24
SEER 249	Nom	VLo-	VLo	VLo-	Nom	EHi	789.79	2.19
SEER 250	Nom	VLo-	VLo	VLo-	EHi	VLo-	835.3	2.31
SEER 251	Nom	VLo-	VLo	VLo-	EHi	Nom	774.67	2.14
SEER 252	Nom	VLo-	VLo	VLo-	EHi	EHi	757.59	2.10
SEER 253	Nom	VLo-	VLo	Nom	VLo-	VLo-	815.04	2.26
SEER 254	Nom	VLo-	VLo	Nom	VLo-	Nom	755.88	2.09
SEER 255	Nom	VLo-	VLo	Nom	VLo-	EHi	739.22	2.05
SEER 256	Nom	VLo-	VLo	Nom	Nom	VLo-	711.39	1.97
SEER 257	Nom	VLo-	VLo	Nom	Nom	Nom	659.76	1.83
SEER 258	Nom	VLo-	VLo	Nom	Nom	EHi	645.21	1.79
SEER 259	Nom	VLo-	VLo	Nom	EHi	VLo-	682.39	1.89
SEER 260	Nom	VLo-	VLo	Nom	EHi	Nom	632.86	1.75
SEER 261	Nom	VLo-	VLo	Nom	EHi	EHi	618.91	1.71
SEER 262	Nom	VLo-	VLo	EHi	VLo-	VLo-	805.64	2.23
SEER 263	Nom	VLo-	VLo	EHi	VLo-	Nom	747.17	2.07
SEER 264	Nom	VLo-	VLo	EHi	VLo-	EHi	730.7	2.02
SEER 265	Nom	VLo-	VLo	EHi	Nom	VLo-	703.19	1.95
SEER 266	Nom	VLo-	VLo	EHi	Nom	Nom	652.15	1.81
SEER 267	Nom	VLo-	VLo	EHi	Nom	EHi	637.78	1.77
SEER 268	Nom	VLo-	VLo	EHi	EHi	VLo-	674.53	1.87
SEER 269	Nom	VLo-	VLo	EHi	EHi	Nom	625.57	1.73
SEER 270	Nom	VLo-	VLo	EHi	EHi	EHi	611.78	1.69
SEER 271	Nom	VLo-	Nom	VLo-	VLo-	VLo-	730.14	2.02
SEER 272	Nom	VLo-	Nom	VLo-	VLo-	Nom	677.15	1.87
SEER 273	Nom	VLo-	Nom	VLo-	VLo-	EHi	662.22	1.83
SEER 274	Nom	VLo-	Nom	VLo-	Nom	VLo-	637.29	1.76
SEER 275	Nom	VLo-	Nom	VLo-	Nom	Nom	591.04	1.64

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 276	Nom	VLo-	Nom	VLo-	Nom	EHi	578.01	1.60
SEER 277	Nom	VLo-	Nom	VLo-	EHi	VLo-	611.31	1.69
SEER 278	Nom	VLo-	Nom	VLo-	EHi	Nom	566.94	1.57
SEER 279	Nom	VLo-	Nom	VLo-	EHi	EHi	554.44	1.53
SEER 280	Nom	VLo-	Nom	Nom	VLo-	VLo-	596.49	1.65
SEER 281	Nom	VLo-	Nom	Nom	VLo-	Nom	553.19	1.53
SEER 282	Nom	VLo-	Nom	Nom	VLo-	EHi	541	1.50
SEER 283	Nom	VLo-	Nom	Nom	Nom	VLo-	520.63	1.44
SEER 284	Nom	VLo-	Nom	Nom	Nom	Nom	482.84	1.34
SEER 285	Nom	VLo-	Nom	Nom	Nom	EHi	472.2	1.31
SEER 286	Nom	VLo-	Nom	Nom	EHi	VLo-	499.41	1.38
SEER 287	Nom	VLo-	Nom	Nom	EHi	Nom	463.16	1.28
SEER 288	Nom	VLo-	Nom	Nom	EHi	EHi	452.95	1.25
SEER 289	Nom	VLo-	Nom	EHi	VLo-	VLo-	589.61	1.63
SEER 290	Nom	VLo-	Nom	EHi	VLo-	Nom	546.82	1.51
SEER 291	Nom	VLo-	Nom	EHi	VLo-	EHi	534.76	1.48
SEER 292	Nom	VLo-	Nom	EHi	Nom	VLo-	514.63	1.42
SEER 293	Nom	VLo-	Nom	EHi	Nom	Nom	477.28	1.32
SEER 294	Nom	VLo-	Nom	EHi	Nom	EHi	466.76	1.29
SEER 295	Nom	VLo-	Nom	EHi	EHi	VLo-	493.65	1.37
SEER 296	Nom	VLo-	Nom	EHi	EHi	Nom	457.82	1.27
SEER 297	Nom	VLo-	Nom	EHi	EHi	EHi	447.73	1.24
SEER 298	Nom	VLo-	VHi	VLo-	VLo-	VLo-	531.5	1.47
SEER 299	Nom	VLo-	VHi	VLo-	VLo-	Nom	492.92	1.36
SEER 300	Nom	VLo-	VHi	VLo-	VLo-	EHi	482.05	1.33
SEER 301	Nom	VLo-	VHi	VLo-	Nom	VLo-	463.91	1.28
SEER 302	Nom	VLo-	VHi	VLo-	Nom	Nom	430.24	1.19
SEER 303	Nom	VLo-	VHi	VLo-	Nom	EHi	420.75	1.16
SEER 304	Nom	VLo-	VHi	VLo-	EHi	VLo-	445	1.23
SEER 305	Nom	VLo-	VHi	VLo-	EHi	Nom	412.7	1.14
SEER 306	Nom	VLo-	VHi	VLo-	EHi	EHi	403.6	1.12
SEER 307	Nom	VLo-	VHi	Nom	VLo-	VLo-	434.21	1.20
SEER 308	Nom	VLo-	VHi	Nom	VLo-	Nom	402.69	1.11
SEER 309	Nom	VLo-	VHi	Nom	VLo-	EHi	393.81	1.09
SEER 310	Nom	VLo-	VHi	Nom	Nom	VLo-	378.99	1.05
SEER 311	Nom	VLo-	VHi	Nom	Nom	Nom	351.48	0.97
SEER 312	Nom	VLo-	VHi	Nom	Nom	EHi	343.73	0.95
SEER 313	Nom	VLo-	VHi	Nom	EHi	VLo-	363.54	1.01
SEER 314	Nom	VLo-	VHi	Nom	EHi	Nom	337.15	0.93
SEER 315	Nom	VLo-	VHi	Nom	EHi	EHi	329.72	0.91
SEER 316	Nom	VLo-	VHi	EHi	VLo-	VLo-	429.2	1.19
SEER 317	Nom	VLo-	VHi	EHi	VLo-	Nom	398.05	1.10
SEER 318	Nom	VLo-	VHi	EHi	VLo-	EHi	389.27	1.08
SEER 319	Nom	VLo-	VHi	EHi	Nom	VLo-	374.62	1.04
SEER 320	Nom	VLo-	VHi	EHi	Nom	Nom	347.43	0.96
SEER 321	Nom	VLo-	VHi	EHi	Nom	EHi	339.77	0.94
SEER 322	Nom	VLo-	VHi	EHi	EHi	VLo-	359.35	0.99
SEER 323	Nom	VLo-	VHi	EHi	EHi	Nom	333.27	0.92
SEER 324	Nom	VLo-	VHi	EHi	EHi	EHi	325.92	0.90
SEER 325	Nom	Nom	VLo	VLo-	VLo-	VLo-	746.53	2.07
SEER 326	Nom	Nom	VLo	VLo-	VLo-	Nom	692.35	1.92
SEER 327	Nom	Nom	VLo	VLo-	VLo-	EHi	677.09	1.87
SEER 328	Nom	Nom	VLo	VLo-	Nom	VLo-	651.6	1.80
SEER 329	Nom	Nom	VLo	VLo-	Nom	Nom	604.31	1.67
SEER 330	Nom	Nom	VLo	VLo-	Nom	EHi	590.98	1.64
SEER 331	Nom	Nom	VLo	VLo-	EHi	VLo-	625.04	1.73
SEER 332	Nom	Nom	VLo	VLo-	EHi	Nom	579.67	1.60
SEER 333	Nom	Nom	VLo	VLo-	EHi	EHi	566.89	1.57
SEER 334	Nom	Nom	VLo	Nom	VLo-	VLo-	609.88	1.69
SEER 335	Nom	Nom	VLo	Nom	VLo-	Nom	565.61	1.57
SEER 336	Nom	Nom	VLo	Nom	VLo-	EHi	553.14	1.53
SEER 337	Nom	Nom	VLo	Nom	Nom	VLo-	532.32	1.47
SEER 338	Nom	Nom	VLo	Nom	Nom	Nom	493.69	1.37
SEER 339	Nom	Nom	VLo	Nom	Nom	EHi	482.8	1.34
SEER 340	Nom	Nom	VLo	Nom	EHi	VLo-	510.62	1.41
SEER 341	Nom	Nom	VLo	Nom	EHi	Nom	473.56	1.31
SEER 342	Nom	Nom	VLo	Nom	EHi	EHi	463.12	1.28
SEER 343	Nom	Nom	VLo	EHi	VLo-	VLo-	602.85	1.67
SEER 344	Nom	Nom	VLo	EHi	VLo-	Nom	559.09	1.55
SEER 345	Nom	Nom	VLo	EHi	VLo-	EHi	546.77	1.51

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 346	Nom	Nom	VLo	EHi	Nom	VLo-	526.19	1.46
SEER 347	Nom	Nom	VLo	EHi	Nom	Nom	488	1.35
SEER 348	Nom	Nom	VLo	EHi	Nom	EHi	477.24	1.32
SEER 349	Nom	Nom	VLo	EHi	EHi	VLo-	504.74	1.40
SEER 350	Nom	Nom	VLo	EHi	EHi	Nom	468.1	1.30
SEER 351	Nom	Nom	VLo	EHi	EHi	EHi	457.78	1.27
SEER 352	Nom	Nom	Nom	VLo-	VLo-	VLo-	546.35	1.51
SEER 353	Nom	Nom	Nom	VLo-	VLo-	Nom	506.7	1.40
SEER 354	Nom	Nom	Nom	VLo-	VLo-	EHi	495.53	1.37
SEER 355	Nom	Nom	Nom	VLo-	Nom	VLo-	476.87	1.32
SEER 356	Nom	Nom	Nom	VLo-	Nom	Nom	442.26	1.22
SEER 357	Nom	Nom	Nom	VLo-	Nom	EHi	432.51	1.20
SEER 358	Nom	Nom	Nom	VLo-	EHi	VLo-	457.43	1.27
SEER 359	Nom	Nom	Nom	VLo-	EHi	Nom	424.23	1.17
SEER 360	Nom	Nom	Nom	VLo-	EHi	EHi	414.88	1.15
SEER 361	Nom	Nom	Nom	Nom	VLo-	VLo-	446.34	1.24
SEER 362	Nom	Nom	Nom	Nom	VLo-	Nom	413.94	1.15
SEER 363	Nom	Nom	Nom	Nom	VLo-	EHi	404.82	1.12
SEER 364	Nom	Nom	Nom	Nom	Nom	VLo-	389.58	1.08
SEER 365	Nom	Nom	Nom	Nom	Nom	Nom	361.3	1.00
SEER 366	Nom	Nom	Nom	Nom	Nom	EHi	353.34	0.98
SEER 367	Nom	Nom	Nom	Nom	EHi	VLo-	373.7	1.03
SEER 368	Nom	Nom	Nom	Nom	EHi	Nom	346.58	0.96
SEER 369	Nom	Nom	Nom	Nom	EHi	EHi	338.94	0.94
SEER 370	Nom	Nom	Nom	EHi	VLo-	VLo-	441.2	1.22
SEER 371	Nom	Nom	Nom	EHi	VLo-	Nom	409.17	1.13
SEER 372	Nom	Nom	Nom	EHi	VLo-	EHi	400.15	1.11
SEER 373	Nom	Nom	Nom	EHi	Nom	VLo-	385.09	1.07
SEER 374	Nom	Nom	Nom	EHi	Nom	Nom	357.14	0.99
SEER 375	Nom	Nom	Nom	EHi	Nom	EHi	349.27	0.97
SEER 376	Nom	Nom	Nom	EHi	EHi	VLo-	369.39	1.02
SEER 377	Nom	Nom	Nom	EHi	EHi	Nom	342.58	0.95
SEER 378	Nom	Nom	Nom	EHi	EHi	EHi	335.03	0.93
SEER 379	Nom	Nom	VHi	VLo-	VLo-	VLo-	397.71	1.10
SEER 380	Nom	Nom	VHi	VLo-	VLo-	Nom	368.85	1.02
SEER 381	Nom	Nom	VHi	VLo-	VLo-	EHi	360.71	1.00
SEER 382	Nom	Nom	VHi	VLo-	Nom	VLo-	347.14	0.96
SEER 383	Nom	Nom	VHi	VLo-	Nom	Nom	321.94	0.89
SEER 384	Nom	Nom	VHi	VLo-	Nom	EHi	314.84	0.87
SEER 385	Nom	Nom	VHi	VLo-	EHi	VLo-	332.99	0.92
SEER 386	Nom	Nom	VHi	VLo-	EHi	Nom	308.82	0.85
SEER 387	Nom	Nom	VHi	VLo-	EHi	EHi	302.01	0.84
SEER 388	Nom	Nom	VHi	Nom	VLo-	VLo-	324.91	0.90
SEER 389	Nom	Nom	VHi	Nom	VLo-	Nom	301.33	0.83
SEER 390	Nom	Nom	VHi	Nom	VLo-	EHi	294.68	0.82
SEER 391	Nom	Nom	VHi	Nom	Nom	VLo-	283.59	0.78
SEER 392	Nom	Nom	VHi	Nom	Nom	Nom	263.01	0.73
SEER 393	Nom	Nom	VHi	Nom	Nom	EHi	257.21	0.71
SEER 394	Nom	Nom	VHi	Nom	EHi	VLo-	272.03	0.75
SEER 395	Nom	Nom	VHi	Nom	EHi	Nom	252.29	0.70
SEER 396	Nom	Nom	VHi	Nom	EHi	EHi	246.72	0.68
SEER 397	Nom	Nom	VHi	EHi	VLo-	VLo-	321.16	0.89
SEER 398	Nom	Nom	VHi	EHi	VLo-	Nom	297.85	0.82
SEER 399	Nom	Nom	VHi	EHi	VLo-	EHi	291.29	0.81
SEER 400	Nom	Nom	VHi	EHi	Nom	VLo-	280.32	0.78
SEER 401	Nom	Nom	VHi	EHi	Nom	Nom	259.98	0.72
SEER 402	Nom	Nom	VHi	EHi	Nom	EHi	254.25	0.70
SEER 403	Nom	Nom	VHi	EHi	EHi	VLo-	268.9	0.74
SEER 404	Nom	Nom	VHi	EHi	EHi	Nom	249.38	0.69
SEER 405	Nom	Nom	VHi	EHi	EHi	EHi	243.88	0.68
SEER 406	Nom	VHi	VLo	VLo-	VLo-	VLo-	667.57	1.85
SEER 407	Nom	VHi	VLo	VLo-	VLo-	Nom	619.12	1.71
SEER 408	Nom	VHi	VLo	VLo-	VLo-	EHi	605.47	1.68
SEER 409	Nom	VHi	VLo	VLo-	Nom	VLo-	582.68	1.61
SEER 410	Nom	VHi	VLo	VLo-	Nom	Nom	540.39	1.50
SEER 411	Nom	VHi	VLo	VLo-	Nom	EHi	528.48	1.46
SEER 412	Nom	VHi	VLo	VLo-	EHi	VLo-	558.93	1.55
SEER 413	Nom	VHi	VLo	VLo-	EHi	Nom	518.36	1.43
SEER 414	Nom	VHi	VLo	VLo-	EHi	EHi	506.93	1.40
SEER 415	Nom	VHi	VLo	Nom	VLo-	VLo-	545.37	1.51

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 416	Nom	VHi	VLo	Nom	VLo-	Nom	505.79	1.40
SEER 417	Nom	VHi	VLo	Nom	VLo-	EHi	494.64	1.37
SEER 418	Nom	VHi	VLo	Nom	Nom	VLo-	476.02	1.32
SEER 419	Nom	VHi	VLo	Nom	Nom	Nom	441.47	1.22
SEER 420	Nom	VHi	VLo	Nom	Nom	EHi	431.74	1.19
SEER 421	Nom	VHi	VLo	Nom	EHi	VLo-	456.61	1.26
SEER 422	Nom	VHi	VLo	Nom	EHi	Nom	423.47	1.17
SEER 423	Nom	VHi	VLo	Nom	EHi	EHi	414.14	1.15
SEER 424	Nom	VHi	VLo	EHi	VLo-	VLo-	539.09	1.49
SEER 425	Nom	VHi	VLo	EHi	VLo-	Nom	499.96	1.38
SEER 426	Nom	VHi	VLo	EHi	VLo-	EHi	488.94	1.35
SEER 427	Nom	VHi	VLo	EHi	Nom	VLo-	470.53	1.30
SEER 428	Nom	VHi	VLo	EHi	Nom	Nom	436.38	1.21
SEER 429	Nom	VHi	VLo	EHi	Nom	EHi	426.76	1.18
SEER 430	Nom	VHi	VLo	EHi	EHi	VLo-	451.35	1.25
SEER 431	Nom	VHi	VLo	EHi	EHi	Nom	418.59	1.16
SEER 432	Nom	VHi	VLo	EHi	EHi	EHi	409.36	1.13
SEER 433	Nom	VHi	Nom	VLo-	VLo-	VLo-	488.56	1.35
SEER 434	Nom	VHi	Nom	VLo-	VLo-	Nom	453.1	1.25
SEER 435	Nom	VHi	Nom	VLo-	VLo-	EHi	443.11	1.23
SEER 436	Nom	VHi	Nom	VLo-	Nom	VLo-	426.44	1.18
SEER 437	Nom	VHi	Nom	VLo-	Nom	Nom	395.48	1.09
SEER 438	Nom	VHi	Nom	VLo-	Nom	EHi	386.77	1.07
SEER 439	Nom	VHi	Nom	VLo-	EHi	VLo-	409.05	1.13
SEER 440	Nom	VHi	Nom	VLo-	EHi	Nom	379.36	1.05
SEER 441	Nom	VHi	Nom	VLo-	EHi	EHi	371	1.03
SEER 442	Nom	VHi	Nom	Nom	VLo-	VLo-	399.13	1.10
SEER 443	Nom	VHi	Nom	Nom	VLo-	Nom	370.16	1.02
SEER 444	Nom	VHi	Nom	Nom	VLo-	EHi	362	1.00
SEER 445	Nom	VHi	Nom	Nom	Nom	VLo-	348.37	0.96
SEER 446	Nom	VHi	Nom	Nom	Nom	Nom	323.09	0.89
SEER 447	Nom	VHi	Nom	Nom	Nom	EHi	315.97	0.87
SEER 448	Nom	VHi	Nom	Nom	EHi	VLo-	334.17	0.92
SEER 449	Nom	VHi	Nom	Nom	EHi	Nom	309.92	0.86
SEER 450	Nom	VHi	Nom	Nom	EHi	EHi	303.09	0.84
SEER 451	Nom	VHi	Nom	EHi	VLo-	VLo-	394.53	1.09
SEER 452	Nom	VHi	Nom	EHi	VLo-	Nom	365.9	1.01
SEER 453	Nom	VHi	Nom	EHi	VLo-	EHi	357.83	0.99
SEER 454	Nom	VHi	Nom	EHi	Nom	VLo-	344.36	0.95
SEER 455	Nom	VHi	Nom	EHi	Nom	Nom	319.37	0.88
SEER 456	Nom	VHi	Nom	EHi	Nom	EHi	312.32	0.86
SEER 457	Nom	VHi	Nom	EHi	EHi	VLo-	330.32	0.91
SEER 458	Nom	VHi	Nom	EHi	EHi	Nom	306.35	0.85
SEER 459	Nom	VHi	Nom	EHi	EHi	EHi	299.59	0.83
SEER 460	Nom	VHi	VHi	VLo-	VLo-	VLo-	355.65	0.98
SEER 461	Nom	VHi	VHi	VLo-	VLo-	Nom	329.83	0.91
SEER 462	Nom	VHi	VHi	VLo-	VLo-	EHi	322.56	0.89
SEER 463	Nom	VHi	VHi	VLo-	Nom	VLo-	310.42	0.86
SEER 464	Nom	VHi	VHi	VLo-	Nom	Nom	287.89	0.80
SEER 465	Nom	VHi	VHi	VLo-	Nom	EHi	281.54	0.78
SEER 466	Nom	VHi	VHi	VLo-	EHi	VLo-	297.77	0.82
SEER 467	Nom	VHi	VHi	VLo-	EHi	Nom	276.15	0.76
SEER 468	Nom	VHi	VHi	VLo-	EHi	EHi	270.07	0.75
SEER 469	Nom	VHi	VHi	Nom	VLo-	VLo-	290.54	0.80
SEER 470	Nom	VHi	VHi	Nom	VLo-	Nom	269.46	0.75
SEER 471	Nom	VHi	VHi	Nom	VLo-	EHi	263.51	0.73
SEER 472	Nom	VHi	VHi	Nom	Nom	VLo-	253.6	0.70
SEER 473	Nom	VHi	VHi	Nom	Nom	Nom	235.19	0.65
SEER 474	Nom	VHi	VHi	Nom	Nom	EHi	230	0.64
SEER 475	Nom	VHi	VHi	Nom	EHi	VLo-	243.26	0.67
SEER 476	Nom	VHi	VHi	Nom	EHi	Nom	225.6	0.62
SEER 477	Nom	VHi	VHi	Nom	EHi	EHi	220.63	0.61
SEER 478	Nom	VHi	VHi	EHi	VLo-	VLo-	287.19	0.79
SEER 479	Nom	VHi	VHi	EHi	VLo-	Nom	266.35	0.74
SEER 480	Nom	VHi	VHi	EHi	VLo-	EHi	260.48	0.72
SEER 481	Nom	VHi	VHi	EHi	Nom	VLo-	250.67	0.69
SEER 482	Nom	VHi	VHi	EHi	Nom	Nom	232.48	0.64
SEER 483	Nom	VHi	VHi	EHi	Nom	EHi	227.35	0.63
SEER 484	Nom	VHi	VHi	EHi	EHi	VLo-	240.45	0.67
SEER 485	Nom	VHi	VHi	EHi	EHi	Nom	223	0.62

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 486	Nom	VHi	VHi	EHi	EHi	EHi	218.09	0.60
SEER 487	VHi	VLo-	VLo	VLo-	VLo-	VLo-	735.47	2.04
SEER 488	VHi	VLo-	VLo	VLo-	VLo-	Nom	682.09	1.89
SEER 489	VHi	VLo-	VLo	VLo-	VLo-	EHi	667.05	1.85
SEER 490	VHi	VLo-	VLo	VLo-	Nom	VLo-	641.94	1.78
SEER 491	VHi	VLo-	VLo	VLo-	Nom	Nom	595.35	1.65
SEER 492	VHi	VLo-	VLo	VLo-	Nom	EHi	582.22	1.61
SEER 493	VHi	VLo-	VLo	VLo-	EHi	VLo-	615.77	1.70
SEER 494	VHi	VLo-	VLo	VLo-	EHi	Nom	571.08	1.58
SEER 495	VHi	VLo-	VLo	VLo-	EHi	EHi	558.49	1.55
SEER 496	VHi	VLo-	VLo	Nom	VLo-	VLo-	600.84	1.66
SEER 497	VHi	VLo-	VLo	Nom	VLo-	Nom	557.23	1.54
SEER 498	VHi	VLo-	VLo	Nom	VLo-	EHi	544.94	1.51
SEER 499	VHi	VLo-	VLo	Nom	Nom	VLo-	524.43	1.45
SEER 500	VHi	VLo-	VLo	Nom	Nom	Nom	486.37	1.35
SEER 501	VHi	VLo-	VLo	Nom	Nom	EHi	475.65	1.32
SEER 502	VHi	VLo-	VLo	Nom	EHi	VLo-	503.05	1.39
SEER 503	VHi	VLo-	VLo	Nom	EHi	Nom	466.54	1.29
SEER 504	VHi	VLo-	VLo	Nom	EHi	EHi	456.26	1.26
SEER 505	VHi	VLo-	VLo	EHi	VLo-	VLo-	593.91	1.64
SEER 506	VHi	VLo-	VLo	EHi	VLo-	Nom	550.81	1.52
SEER 507	VHi	VLo-	VLo	EHi	VLo-	EHi	538.66	1.49
SEER 508	VHi	VLo-	VLo	EHi	Nom	VLo-	518.39	1.43
SEER 509	VHi	VLo-	VLo	EHi	Nom	Nom	480.76	1.33
SEER 510	VHi	VLo-	VLo	EHi	Nom	EHi	470.16	1.30
SEER 511	VHi	VLo-	VLo	EHi	EHi	VLo-	497.26	1.38
SEER 512	VHi	VLo-	VLo	EHi	EHi	Nom	461.16	1.28
SEER 513	VHi	VLo-	VLo	EHi	EHi	EHi	451	1.25
SEER 514	VHi	VLo-	Nom	VLo-	VLo-	VLo-	538.25	1.49
SEER 515	VHi	VLo-	Nom	VLo-	VLo-	Nom	499.19	1.38
SEER 516	VHi	VLo-	Nom	VLo-	VLo-	EHi	488.18	1.35
SEER 517	VHi	VLo-	Nom	VLo-	Nom	VLo-	469.81	1.30
SEER 518	VHi	VLo-	Nom	VLo-	Nom	Nom	435.71	1.21
SEER 519	VHi	VLo-	Nom	VLo-	Nom	EHi	426.1	1.18
SEER 520	VHi	VLo-	Nom	VLo-	EHi	VLo-	450.65	1.25
SEER 521	VHi	VLo-	Nom	VLo-	EHi	Nom	417.95	1.16
SEER 522	VHi	VLo-	Nom	VLo-	EHi	EHi	408.73	1.13
SEER 523	VHi	VLo-	Nom	Nom	VLo-	VLo-	439.72	1.22
SEER 524	VHi	VLo-	Nom	Nom	VLo-	Nom	407.81	1.13
SEER 525	VHi	VLo-	Nom	Nom	VLo-	EHi	398.82	1.10
SEER 526	VHi	VLo-	Nom	Nom	Nom	VLo-	383.81	1.06
SEER 527	VHi	VLo-	Nom	Nom	Nom	Nom	355.95	0.99
SEER 528	VHi	VLo-	Nom	Nom	Nom	EHi	348.1	0.96
SEER 529	VHi	VLo-	Nom	Nom	EHi	VLo-	368.16	1.02
SEER 530	VHi	VLo-	Nom	Nom	EHi	Nom	341.44	0.95
SEER 531	VHi	VLo-	Nom	Nom	EHi	EHi	333.91	0.92
SEER 532	VHi	VLo-	Nom	EHi	VLo-	VLo-	434.66	1.20
SEER 533	VHi	VLo-	Nom	EHi	VLo-	Nom	403.11	1.12
SEER 534	VHi	VLo-	Nom	EHi	VLo-	EHi	394.22	1.09
SEER 535	VHi	VLo-	Nom	EHi	Nom	VLo-	379.38	1.05
SEER 536	VHi	VLo-	Nom	EHi	Nom	Nom	351.85	0.97
SEER 537	VHi	VLo-	Nom	EHi	Nom	EHi	344.09	0.95
SEER 538	VHi	VLo-	Nom	EHi	EHi	VLo-	363.92	1.01
SEER 539	VHi	VLo-	Nom	EHi	EHi	Nom	337.5	0.93
SEER 540	VHi	VLo-	Nom	EHi	EHi	EHi	330.06	0.91
SEER 541	VHi	VLo-	VHi	VLo-	VLo-	VLo-	391.82	1.08
SEER 542	VHi	VLo-	VHi	VLo-	VLo-	Nom	363.38	1.01
SEER 543	VHi	VLo-	VHi	VLo-	VLo-	EHi	355.37	0.98
SEER 544	VHi	VLo-	VHi	VLo-	Nom	VLo-	341.99	0.95
SEER 545	VHi	VLo-	VHi	VLo-	Nom	Nom	317.17	0.88
SEER 546	VHi	VLo-	VHi	VLo-	Nom	EHi	310.18	0.86
SEER 547	VHi	VLo-	VHi	VLo-	EHi	VLo-	328.05	0.91
SEER 548	VHi	VLo-	VHi	VLo-	EHi	Nom	304.24	0.84
SEER 549	VHi	VLo-	VHi	VLo-	EHi	EHi	297.53	0.82
SEER 550	VHi	VLo-	VHi	Nom	VLo-	VLo-	320.09	0.89
SEER 551	VHi	VLo-	VHi	Nom	VLo-	Nom	296.86	0.82
SEER 552	VHi	VLo-	VHi	Nom	VLo-	EHi	290.32	0.80
SEER 553	VHi	VLo-	VHi	Nom	Nom	VLo-	279.39	0.77
SEER 554	VHi	VLo-	VHi	Nom	Nom	Nom	259.11	0.72
SEER 555	VHi	VLo-	VHi	Nom	Nom	EHi	253.4	0.70

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 556	VHi	VLo-	VHi	Nom	EHi	VLo-	268	0.74
SEER 557	VHi	VLo-	VHi	Nom	EHi	Nom	248.55	0.69
SEER 558	VHi	VLo-	VHi	Nom	EHi	EHi	243.07	0.67
SEER 559	VHi	VLo-	VHi	EHi	VLo-	VLo-	316.4	0.88
SEER 560	VHi	VLo-	VHi	EHi	VLo-	Nom	293.44	0.81
SEER 561	VHi	VLo-	VHi	EHi	VLo-	EHi	286.97	0.79
SEER 562	VHi	VLo-	VHi	EHi	Nom	VLo-	276.17	0.76
SEER 563	VHi	VLo-	VHi	EHi	Nom	Nom	256.12	0.71
SEER 564	VHi	VLo-	VHi	EHi	Nom	EHi	250.48	0.69
SEER 565	VHi	VLo-	VHi	EHi	EHi	VLo-	264.91	0.73
SEER 566	VHi	VLo-	VHi	EHi	EHi	Nom	245.68	0.68
SEER 567	VHi	VLo-	VHi	EHi	EHi	EHi	240.27	0.67
SEER 568	VHi	Nom	VLo	VLo-	VLo-	VLo-	550.34	1.52
SEER 569	VHi	Nom	VLo	VLo-	VLo-	Nom	510.39	1.41
SEER 570	VHi	Nom	VLo	VLo-	VLo-	EHi	499.14	1.38
SEER 571	VHi	Nom	VLo	VLo-	Nom	VLo-	480.35	1.33
SEER 572	VHi	Nom	VLo	VLo-	Nom	Nom	445.49	1.23
SEER 573	VHi	Nom	VLo	VLo-	Nom	EHi	435.67	1.21
SEER 574	VHi	Nom	VLo	VLo-	EHi	VLo-	460.77	1.28
SEER 575	VHi	Nom	VLo	VLo-	EHi	Nom	427.33	1.18
SEER 576	VHi	Nom	VLo	VLo-	EHi	EHi	417.91	1.16
SEER 577	VHi	Nom	VLo	Nom	VLo-	VLo-	449.6	1.24
SEER 578	VHi	Nom	VLo	Nom	VLo-	Nom	416.96	1.15
SEER 579	VHi	Nom	VLo	Nom	VLo-	EHi	407.77	1.13
SEER 580	VHi	Nom	VLo	Nom	Nom	VLo-	392.42	1.09
SEER 581	VHi	Nom	VLo	Nom	Nom	Nom	363.94	1.01
SEER 582	VHi	Nom	VLo	Nom	Nom	EHi	355.92	0.99
SEER 583	VHi	Nom	VLo	Nom	EHi	VLo-	376.43	1.04
SEER 584	VHi	Nom	VLo	Nom	EHi	Nom	349.11	0.97
SEER 585	VHi	Nom	VLo	Nom	EHi	EHi	341.41	0.94
SEER 586	VHi	Nom	VLo	EHi	VLo-	VLo-	444.42	1.23
SEER 587	VHi	Nom	VLo	EHi	VLo-	Nom	412.16	1.14
SEER 588	VHi	Nom	VLo	EHi	VLo-	EHi	403.07	1.12
SEER 589	VHi	Nom	VLo	EHi	Nom	VLo-	387.9	1.07
SEER 590	VHi	Nom	VLo	EHi	Nom	Nom	359.75	1.00
SEER 591	VHi	Nom	VLo	EHi	Nom	EHi	351.82	0.97
SEER 592	VHi	Nom	VLo	EHi	EHi	VLo-	372.09	1.03
SEER 593	VHi	Nom	VLo	EHi	EHi	Nom	345.08	0.96
SEER 594	VHi	Nom	VLo	EHi	EHi	EHi	337.47	0.93
SEER 595	VHi	Nom	Nom	VLo-	VLo-	VLo-	402.77	1.11
SEER 596	VHi	Nom	Nom	VLo-	VLo-	Nom	373.53	1.03
SEER 597	VHi	Nom	Nom	VLo-	VLo-	EHi	365.3	1.01
SEER 598	VHi	Nom	Nom	VLo-	Nom	VLo-	351.55	0.97
SEER 599	VHi	Nom	Nom	VLo-	Nom	Nom	326.03	0.90
SEER 600	VHi	Nom	Nom	VLo-	Nom	EHi	318.84	0.88
SEER 601	VHi	Nom	Nom	VLo-	EHi	VLo-	337.22	0.93
SEER 602	VHi	Nom	Nom	VLo-	EHi	Nom	312.74	0.87
SEER 603	VHi	Nom	Nom	VLo-	EHi	EHi	305.85	0.85
SEER 604	VHi	Nom	Nom	Nom	VLo-	VLo-	329.04	0.91
SEER 605	VHi	Nom	Nom	Nom	VLo-	Nom	305.16	0.84
SEER 606	VHi	Nom	Nom	Nom	VLo-	EHi	298.43	0.83
SEER 607	VHi	Nom	Nom	Nom	Nom	VLo-	287.2	0.79
SEER 608	VHi	Nom	Nom	Nom	Nom	Nom	266.35	0.74
SEER 609	VHi	Nom	Nom	Nom	Nom	EHi	260.48	0.72
SEER 610	VHi	Nom	Nom	Nom	EHi	VLo-	275.49	0.76
SEER 611	VHi	Nom	Nom	Nom	EHi	Nom	255.49	0.71
SEER 612	VHi	Nom	Nom	Nom	EHi	EHi	249.86	0.69
SEER 613	VHi	Nom	Nom	EHi	VLo-	VLo-	325.25	0.90
SEER 614	VHi	Nom	Nom	EHi	VLo-	Nom	301.64	0.83
SEER 615	VHi	Nom	Nom	EHi	VLo-	EHi	294.99	0.82
SEER 616	VHi	Nom	Nom	EHi	Nom	VLo-	283.89	0.79
SEER 617	VHi	Nom	Nom	EHi	Nom	Nom	263.28	0.73
SEER 618	VHi	Nom	Nom	EHi	Nom	EHi	257.48	0.71
SEER 619	VHi	Nom	Nom	EHi	EHi	VLo-	272.31	0.75
SEER 620	VHi	Nom	Nom	EHi	EHi	Nom	252.55	0.70
SEER 621	VHi	Nom	Nom	EHi	EHi	EHi	246.98	0.68
SEER 622	VHi	Nom	VHi	VLo-	VLo-	VLo-	293.19	0.81
SEER 623	VHi	Nom	VHi	VLo-	VLo-	Nom	271.91	0.75
SEER 624	VHi	Nom	VHi	VLo-	VLo-	EHi	265.91	0.74
SEER 625	VHi	Nom	VHi	VLo-	Nom	VLo-	255.91	0.71

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 626	VHi	Nom	VHi	VLo-	Nom	Nom	237.33	0.66
SEER 627	VHi	Nom	VHi	VLo-	Nom	EHi	232.1	0.64
SEER 628	VHi	Nom	VHi	VLo-	EHi	VLo-	245.47	0.68
SEER 629	VHi	Nom	VHi	VLo-	EHi	Nom	227.66	0.63
SEER 630	VHi	Nom	VHi	VLo-	EHi	EHi	222.64	0.62
SEER 631	VHi	Nom	VHi	Nom	VLo-	VLo-	239.52	0.66
SEER 632	VHi	Nom	VHi	Nom	VLo-	Nom	222.14	0.61
SEER 633	VHi	Nom	VHi	Nom	VLo-	EHi	217.24	0.60
SEER 634	VHi	Nom	VHi	Nom	Nom	VLo-	209.06	0.58
SEER 635	VHi	Nom	VHi	Nom	Nom	Nom	193.89	0.54
SEER 636	VHi	Nom	VHi	Nom	Nom	EHi	189.61	0.52
SEER 637	VHi	Nom	VHi	Nom	EHi	VLo-	200.54	0.56
SEER 638	VHi	Nom	VHi	Nom	EHi	Nom	185.98	0.51
SEER 639	VHi	Nom	VHi	Nom	EHi	EHi	181.88	0.50
SEER 640	VHi	Nom	VHi	EHi	VLo-	VLo-	236.76	0.66
SEER 641	VHi	Nom	VHi	EHi	VLo-	Nom	219.58	0.61
SEER 642	VHi	Nom	VHi	EHi	VLo-	EHi	214.73	0.59
SEER 643	VHi	Nom	VHi	EHi	Nom	VLo-	206.65	0.57
SEER 644	VHi	Nom	VHi	EHi	Nom	Nom	191.65	0.53
SEER 645	VHi	Nom	VHi	EHi	Nom	EHi	187.43	0.52
SEER 646	VHi	Nom	VHi	EHi	EHi	VLo-	198.23	0.55
SEER 647	VHi	Nom	VHi	EHi	EHi	Nom	183.84	0.51
SEER 648	VHi	Nom	VHi	EHi	EHi	EHi	179.79	0.50
SEER 649	VHi	VHi	VLo	VLo-	VLo-	VLo-	492.13	1.36
SEER 650	VHi	VHi	VLo	VLo-	VLo-	Nom	456.41	1.26
SEER 651	VHi	VHi	VLo	VLo-	VLo-	EHi	446.35	1.24
SEER 652	VHi	VHi	VLo	VLo-	Nom	VLo-	429.55	1.19
SEER 653	VHi	VHi	VLo	VLo-	Nom	Nom	398.37	1.10
SEER 654	VHi	VHi	VLo	VLo-	Nom	EHi	389.59	1.08
SEER 655	VHi	VHi	VLo	VLo-	EHi	VLo-	412.04	1.14
SEER 656	VHi	VHi	VLo	VLo-	EHi	Nom	382.13	1.06
SEER 657	VHi	VHi	VLo	VLo-	EHi	EHi	373.71	1.03
SEER 658	VHi	VHi	VLo	Nom	VLo-	VLo-	402.04	1.11
SEER 659	VHi	VHi	VLo	Nom	VLo-	Nom	372.86	1.03
SEER 660	VHi	VHi	VLo	Nom	VLo-	EHi	364.64	1.01
SEER 661	VHi	VHi	VLo	Nom	Nom	VLo-	350.92	0.97
SEER 662	VHi	VHi	VLo	Nom	Nom	Nom	325.45	0.90
SEER 663	VHi	VHi	VLo	Nom	Nom	EHi	318.27	0.88
SEER 664	VHi	VHi	VLo	Nom	EHi	VLo-	336.61	0.93
SEER 665	VHi	VHi	VLo	Nom	EHi	Nom	312.18	0.86
SEER 666	VHi	VHi	VLo	Nom	EHi	EHi	305.3	0.85
SEER 667	VHi	VHi	VLo	EHi	VLo-	VLo-	397.41	1.10
SEER 668	VHi	VHi	VLo	EHi	VLo-	Nom	368.57	1.02
SEER 669	VHi	VHi	VLo	EHi	VLo-	EHi	360.44	1.00
SEER 670	VHi	VHi	VLo	EHi	Nom	VLo-	346.87	0.96
SEER 671	VHi	VHi	VLo	EHi	Nom	Nom	321.7	0.89
SEER 672	VHi	VHi	VLo	EHi	Nom	EHi	314.6	0.87
SEER 673	VHi	VHi	VLo	EHi	EHi	VLo-	332.73	0.92
SEER 674	VHi	VHi	VLo	EHi	EHi	Nom	308.58	0.85
SEER 675	VHi	VHi	VLo	EHi	EHi	EHi	301.78	0.84
SEER 676	VHi	VHi	Nom	VLo-	VLo-	VLo-	360.17	1.00
SEER 677	VHi	VHi	Nom	VLo-	VLo-	Nom	334.02	0.92
SEER 678	VHi	VHi	Nom	VLo-	VLo-	EHi	326.66	0.90
SEER 679	VHi	VHi	Nom	VLo-	Nom	VLo-	314.36	0.87
SEER 680	VHi	VHi	Nom	VLo-	Nom	Nom	291.55	0.81
SEER 681	VHi	VHi	Nom	VLo-	Nom	EHi	285.12	0.79
SEER 682	VHi	VHi	Nom	VLo-	EHi	VLo-	301.55	0.83
SEER 683	VHi	VHi	Nom	VLo-	EHi	Nom	279.66	0.77
SEER 684	VHi	VHi	Nom	VLo-	EHi	EHi	273.5	0.76
SEER 685	VHi	VHi	Nom	Nom	VLo-	VLo-	294.24	0.81
SEER 686	VHi	VHi	Nom	Nom	VLo-	Nom	272.88	0.76
SEER 687	VHi	VHi	Nom	Nom	VLo-	EHi	266.86	0.74
SEER 688	VHi	VHi	Nom	Nom	Nom	VLo-	256.82	0.71
SEER 689	VHi	VHi	Nom	Nom	Nom	Nom	238.18	0.66
SEER 690	VHi	VHi	Nom	Nom	Nom	EHi	232.93	0.64
SEER 691	VHi	VHi	Nom	Nom	EHi	VLo-	246.35	0.68
SEER 692	VHi	VHi	Nom	Nom	EHi	Nom	228.47	0.63
SEER 693	VHi	VHi	Nom	Nom	EHi	EHi	223.43	0.62
SEER 694	VHi	VHi	Nom	EHi	VLo-	VLo-	290.84	0.80
SEER 695	VHi	VHi	Nom	EHi	VLo-	Nom	269.73	0.75

Run	Analyst Capabilities	Analyst's Application Experience	Programmer Capabilities	Programmer's Language Experience	Development System Experience	Target System Experience	Development Effort Months	Change from Nominal
SEER 696	VHi	VHi	Nom	EHi	VLo-	EHi	263.79	0.73
SEER 697	VHi	VHi	Nom	EHi	Nom	VLo-	253.86	0.70
SEER 698	VHi	VHi	Nom	EHi	Nom	Nom	235.43	0.65
SEER 699	VHi	VHi	Nom	EHi	Nom	EHi	230.24	0.64
SEER 700	VHi	VHi	Nom	EHi	EHi	VLo-	243.51	0.67
SEER 701	VHi	VHi	Nom	EHi	EHi	Nom	225.84	0.63
SEER 702	VHi	VHi	Nom	EHi	EHi	EHi	220.86	0.61
SEER 703	VHi	VHi	VHi	VLo-	VLo-	VLo-	262.18	0.73
SEER 704	VHi	VHi	VHi	VLo-	VLo-	Nom	243.15	0.67
SEER 705	VHi	VHi	VHi	VLo-	VLo-	EHi	237.79	0.66
SEER 706	VHi	VHi	VHi	VLo-	Nom	VLo-	228.84	0.63
SEER 707	VHi	VHi	VHi	VLo-	Nom	Nom	212.23	0.59
SEER 708	VHi	VHi	VHi	VLo-	Nom	EHi	207.55	0.57
SEER 709	VHi	VHi	VHi	VLo-	EHi	VLo-	219.51	0.61
SEER 710	VHi	VHi	VHi	VLo-	EHi	Nom	203.58	0.56
SEER 711	VHi	VHi	VHi	VLo-	EHi	EHi	199.09	0.55
SEER 712	VHi	VHi	VHi	Nom	VLo-	VLo-	214.19	0.59
SEER 713	VHi	VHi	VHi	Nom	VLo-	Nom	198.64	0.55
SEER 714	VHi	VHi	VHi	Nom	VLo-	EHi	194.26	0.54
SEER 715	VHi	VHi	VHi	Nom	Nom	VLo-	186.95	0.52
SEER 716	VHi	VHi	VHi	Nom	Nom	Nom	173.38	0.48
SEER 717	VHi	VHi	VHi	Nom	Nom	EHi	169.56	0.47
SEER 718	VHi	VHi	VHi	Nom	EHi	VLo-	179.33	0.50
SEER 719	VHi	VHi	VHi	Nom	EHi	Nom	166.31	0.46
SEER 720	VHi	VHi	VHi	Nom	EHi	EHi	162.65	0.45
SEER 721	VHi	VHi	VHi	EHi	VLo-	VLo-	211.72	0.59
SEER 722	VHi	VHi	VHi	EHi	VLo-	Nom	196.35	0.54
SEER 723	VHi	VHi	VHi	EHi	VLo-	EHi	192.02	0.53
SEER 724	VHi	VHi	VHi	EHi	Nom	VLo-	184.79	0.51
SEER 725	VHi	VHi	VHi	EHi	Nom	Nom	171.38	0.47
SEER 726	VHi	VHi	VHi	EHi	Nom	EHi	167.6	0.46
SEER 727	VHi	VHi	VHi	EHi	EHi	VLo-	177.26	0.49
SEER 728	VHi	VHi	VHi	EHi	EHi	Nom	164.4	0.46
SEER 729	VHi	VHi	VHi	EHi	EHi	EHi	160.77	0.44

Appendix 9 SLIM Data Table

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 1	Low	Low	Low	Low	Low	Low	273.83	1.07
SLIM 2	Low	Low	Low	Low	Low	Nom	299.23	1.17
SLIM 3	Low	Low	Low	Low	Low	Hi	310.16	1.22
SLIM 4	Low	Low	Low	Low	Nom	Low	263.87	1.04
SLIM 5	Low	Low	Low	Low	Nom	Nom	293.88	1.15
SLIM 6	Low	Low	Low	Low	Nom	Hi	310.16	1.22
SLIM 7	Low	Low	Low	Low	Hi	Low	250.25	0.98
SLIM 8	Low	Low	Low	Low	Hi	Nom	268.79	1.06
SLIM 9	Low	Low	Low	Low	Hi	Hi	283.77	1.11
SLIM 10	Low	Low	Low	Nom	Low	Low	263.87	1.04
SLIM 11	Low	Low	Low	Nom	Low	Nom	293.88	1.15
SLIM 12	Low	Low	Low	Nom	Low	Hi	304.52	1.20
SLIM 13	Low	Low	Low	Nom	Nom	Low	254.73	1.00
SLIM 14	Low	Low	Low	Nom	Nom	Nom	283.77	1.11
SLIM 15	Low	Low	Low	Nom	Nom	Hi	304.52	1.20
SLIM 16	Low	Low	Low	Nom	Hi	Low	237.09	0.93
SLIM 17	Low	Low	Low	Nom	Hi	Nom	254.73	1.00
SLIM 18	Low	Low	Low	Nom	Hi	Hi	278.61	1.09
SLIM 19	Low	Low	Low	Hi	Low	Low	245.72	0.96
SLIM 20	Low	Low	Low	Hi	Low	Nom	263.87	1.04
SLIM 21	Low	Low	Low	Hi	Low	Hi	278.61	1.09
SLIM 22	Low	Low	Low	Hi	Nom	Low	237.09	0.93
SLIM 23	Low	Low	Low	Hi	Nom	Nom	250.25	0.98
SLIM 24	Low	Low	Low	Hi	Nom	Hi	273.83	1.07
SLIM 25	Low	Low	Low	Hi	Hi	Low	229.08	0.90
SLIM 26	Low	Low	Low	Hi	Hi	Nom	237.09	0.93
SLIM 27	Low	Low	Low	Hi	Hi	Hi	259.55	1.02
SLIM 28	Low	Low	Nom	Low	Low	Low	263.87	1.04
SLIM 29	Low	Low	Nom	Low	Low	Nom	293.88	1.15
SLIM 30	Low	Low	Nom	Low	Low	Hi	304.52	1.20
SLIM 31	Low	Low	Nom	Low	Nom	Low	250.25	0.98
SLIM 32	Low	Low	Nom	Low	Nom	Nom	283.86	1.11
SLIM 33	Low	Low	Nom	Low	Nom	Hi	304.52	1.20
SLIM 34	Low	Low	Nom	Low	Hi	Low	237.09	0.93
SLIM 35	Low	Low	Nom	Low	Hi	Nom	254.73	1.00
SLIM 36	Low	Low	Nom	Low	Hi	Hi	278.61	1.09
SLIM 37	Low	Low	Nom	Nom	Low	Low	250.25	0.98
SLIM 38	Low	Low	Nom	Nom	Low	Nom	278.61	1.09
SLIM 39	Low	Low	Nom	Nom	Low	Hi	299.23	1.17
SLIM 40	Low	Low	Nom	Nom	Nom	Low	233.29	0.92
SLIM 41	Low	Low	Nom	Nom	Nom	Nom	259.55	1.02
SLIM 42	Low	Low	Nom	Nom	Nom	Hi	293.88	1.15
SLIM 43	Low	Low	Nom	Nom	Hi	Low	221.01	0.87
SLIM 44	Low	Low	Nom	Nom	Hi	Nom	233.29	0.92
SLIM 45	Low	Low	Nom	Nom	Hi	Hi	268.79	1.06
SLIM 46	Low	Low	Nom	Hi	Low	Low	233.29	0.92
SLIM 47	Low	Low	Nom	Hi	Low	Nom	250.25	0.98
SLIM 48	Low	Low	Nom	Hi	Low	Hi	273.83	1.07
SLIM 49	Low	Low	Nom	Hi	Nom	Low	221.01	0.87
SLIM 50	Low	Low	Nom	Hi	Nom	Nom	233.29	0.92
SLIM 51	Low	Low	Nom	Hi	Nom	Hi	263.29	1.03
SLIM 52	Low	Low	Nom	Hi	Hi	Low	213.16	0.84
SLIM 53	Low	Low	Nom	Hi	Hi	Nom	221.01	0.87
SLIM 54	Low	Low	Nom	Hi	Hi	Hi	250.25	0.98
SLIM 55	Low	Low	Hi	Low	Low	Low	245.72	0.96
SLIM 56	Low	Low	Hi	Low	Low	Nom	263.87	1.04
SLIM 57	Low	Low	Hi	Low	Low	Hi	278.61	1.09
SLIM 58	Low	Low	Hi	Low	Nom	Low	237.09	0.93
SLIM 59	Low	Low	Hi	Low	Nom	Nom	250.25	0.98
SLIM 60	Low	Low	Hi	Low	Nom	Hi	273.83	1.07
SLIM 61	Low	Low	Hi	Low	Hi	Low	229.08	0.90
SLIM 62	Low	Low	Hi	Low	Hi	Nom	237.09	0.93
SLIM 63	Low	Low	Hi	Low	Hi	Hi	259.55	1.02
SLIM 64	Low	Low	Hi	Nom	Low	Low	233.29	0.92
SLIM 65	Low	Low	Hi	Nom	Low	Nom	250.25	0.98

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 66	Low	Low	Hi	Nom	Low	Hi	273.83	1.07
SLIM 67	Low	Low	Hi	Nom	Nom	Low	221.01	0.87
SLIM 68	Low	Low	Hi	Nom	Nom	Nom	233.29	0.92
SLIM 69	Low	Low	Hi	Nom	Nom	Hi	263.87	1.04
SLIM 70	Low	Low	Hi	Nom	Hi	Low	213.16	0.84
SLIM 71	Low	Low	Hi	Nom	Hi	Nom	221.01	0.87
SLIM 72	Low	Low	Hi	Nom	Hi	Hi	250.25	0.98
SLIM 73	Low	Low	Hi	Hi	Low	Low	225.34	0.88
SLIM 74	Low	Low	Hi	Hi	Low	Nom	233.29	0.92
SLIM 75	Low	Low	Hi	Hi	Low	Hi	254.73	1.00
SLIM 76	Low	Low	Hi	Hi	Nom	Low	213.16	0.84
SLIM 77	Low	Low	Hi	Hi	Nom	Nom	221.01	0.87
SLIM 78	Low	Low	Hi	Hi	Nom	Hi	245.72	0.96
SLIM 79	Low	Low	Hi	Hi	Hi	Low	209.28	0.82
SLIM 80	Low	Low	Hi	Hi	Hi	Nom	213.16	0.84
SLIM 81	Low	Low	Hi	Hi	Hi	Hi	237.09	0.93
SLIM 82	Low	Nom	Low	Low	Low	Low	293.88	1.15
SLIM 83	Low	Nom	Low	Low	Low	Nom	338.74	1.33
SLIM 84	Low	Nom	Low	Low	Low	Hi	338.74	1.33
SLIM 85	Low	Nom	Low	Low	Nom	Low	288.54	1.13
SLIM 86	Low	Nom	Low	Low	Nom	Nom	338.74	1.33
SLIM 87	Low	Nom	Low	Low	Nom	Hi	338.74	1.33
SLIM 88	Low	Nom	Low	Low	Hi	Low	263.87	1.04
SLIM 89	Low	Nom	Low	Low	Hi	Nom	288.54	1.13
SLIM 90	Low	Nom	Low	Low	Hi	Hi	304.52	1.20
SLIM 91	Low	Nom	Low	Nom	Low	Low	283.77	1.11
SLIM 92	Low	Nom	Low	Nom	Low	Nom	338.74	1.33
SLIM 93	Low	Nom	Low	Nom	Low	Hi	338.74	1.33
SLIM 94	Low	Nom	Low	Nom	Nom	Low	274.83	1.08
SLIM 95	Low	Nom	Low	Nom	Nom	Nom	338.74	1.33
SLIM 96	Low	Nom	Low	Nom	Nom	Hi	338.74	1.33
SLIM 97	Low	Nom	Low	Nom	Hi	Low	250.25	0.98
SLIM 98	Low	Nom	Low	Nom	Hi	Nom	278.61	1.09
SLIM 99	Low	Nom	Low	Nom	Hi	Hi	299.23	1.17
SLIM 100	Low	Nom	Low	Hi	Low	Low	259.55	1.02
SLIM 101	Low	Nom	Low	Hi	Low	Nom	283.77	1.11
SLIM 102	Low	Nom	Low	Hi	Low	Hi	299.23	1.17
SLIM 103	Low	Nom	Low	Hi	Nom	Low	245.72	0.96
SLIM 104	Low	Nom	Low	Hi	Nom	Nom	273.83	1.07
SLIM 105	Low	Nom	Low	Hi	Nom	Hi	293.88	1.15
SLIM 106	Low	Nom	Low	Hi	Hi	Low	237.09	0.93
SLIM 107	Low	Nom	Low	Hi	Hi	Nom	250.25	0.98
SLIM 108	Low	Nom	Low	Hi	Hi	Hi	273.83	1.07
SLIM 109	Low	Nom	Nom	Low	Low	Low	283.77	1.11
SLIM 110	Low	Nom	Nom	Low	Low	Nom	338.74	1.33
SLIM 111	Low	Nom	Nom	Low	Low	Hi	338.74	1.33
SLIM 112	Low	Nom	Nom	Low	Nom	Low	274.83	1.08
SLIM 113	Low	Nom	Nom	Low	Nom	Nom	338.74	1.33
SLIM 114	Low	Nom	Nom	Low	Nom	Hi	338.74	1.33
SLIM 115	Low	Nom	Nom	Low	Hi	Low	250.25	0.98
SLIM 116	Low	Nom	Nom	Low	Hi	Nom	278.61	1.09
SLIM 117	Low	Nom	Nom	Low	Hi	Hi	299.23	1.17
SLIM 118	Low	Nom	Nom	Nom	Low	Low	268.79	1.06
SLIM 119	Low	Nom	Nom	Nom	Low	Nom	338.74	1.33
SLIM 120	Low	Nom	Nom	Nom	Low	Hi	338.74	1.33
SLIM 121	Low	Nom	Nom	Nom	Nom	Low	250.25	0.98
SLIM 122	Low	Nom	Nom	Nom	Nom	Nom	338.74	1.33
SLIM 123	Low	Nom	Nom	Nom	Nom	Hi	338.74	1.33
SLIM 124	Low	Nom	Nom	Nom	Hi	Low	229.08	0.90
SLIM 125	Low	Nom	Nom	Nom	Hi	Nom	254.73	1.00
SLIM 126	Low	Nom	Nom	Nom	Hi	Hi	288.54	1.13
SLIM 127	Low	Nom	Nom	Hi	Low	Low	245.72	0.96
SLIM 128	Low	Nom	Nom	Hi	Low	Nom	268.79	1.06
SLIM 129	Low	Nom	Nom	Hi	Low	Hi	293.88	1.15
SLIM 130	Low	Nom	Nom	Hi	Nom	Low	229.08	0.90
SLIM 131	Low	Nom	Nom	Hi	Nom	Nom	250.25	0.98
SLIM 132	Low	Nom	Nom	Hi	Nom	Hi	283.77	1.11
SLIM 133	Low	Nom	Nom	Hi	Hi	Low	216.94	0.85
SLIM 134	Low	Nom	Nom	Hi	Hi	Nom	229.08	0.90
SLIM 135	Low	Nom	Nom	Hi	Hi	Hi	259.55	1.02

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 136	Low	Nom	Hi	Low	Low	Low	259.55	1.02
SLIM 137	Low	Nom	Hi	Low	Low	Nom	283.77	1.11
SLIM 138	Low	Nom	Hi	Low	Low	Hi	299.23	1.17
SLIM 139	Low	Nom	Hi	Low	Nom	Low	245.72	0.96
SLIM 140	Low	Nom	Hi	Low	Nom	Nom	268.79	1.06
SLIM 141	Low	Nom	Hi	Low	Nom	Hi	293.88	1.15
SLIM 142	Low	Nom	Hi	Low	Hi	Low	233.29	0.92
SLIM 143	Low	Nom	Hi	Low	Hi	Nom	250.25	0.98
SLIM 144	Low	Nom	Hi	Low	Hi	Hi	273.83	1.07
SLIM 145	Low	Nom	Hi	Nom	Low	Low	245.74	0.96
SLIM 146	Low	Nom	Hi	Nom	Low	Nom	268.79	1.06
SLIM 147	Low	Nom	Hi	Nom	Low	Hi	293.88	1.15
SLIM 148	Low	Nom	Hi	Nom	Nom	Low	229.08	0.90
SLIM 149	Low	Nom	Hi	Nom	Nom	Nom	250.25	0.98
SLIM 150	Low	Nom	Hi	Nom	Nom	Hi	283.77	1.11
SLIM 151	Low	Nom	Hi	Nom	Hi	Low	216.94	0.85
SLIM 152	Low	Nom	Hi	Nom	Hi	Nom	229.08	0.90
SLIM 153	Low	Nom	Hi	Nom	Hi	Hi	259.55	1.02
SLIM 154	Low	Nom	Hi	Hi	Low	Low	233.29	0.92
SLIM 155	Low	Nom	Hi	Hi	Low	Nom	241.3	0.95
SLIM 156	Low	Nom	Hi	Hi	Low	Hi	268.79	1.06
SLIM 157	Low	Nom	Hi	Hi	Nom	Low	216.94	0.85
SLIM 158	Low	Nom	Hi	Hi	Nom	Nom	225.34	0.88
SLIM 159	Low	Nom	Hi	Hi	Nom	Hi	259.55	1.02
SLIM 160	Low	Nom	Hi	Hi	Hi	Low	213.16	0.84
SLIM 161	Low	Nom	Hi	Hi	Hi	Nom	216.94	0.85
SLIM 162	Low	Nom	Hi	Hi	Hi	Hi	245.72	0.96
SLIM 163	Low	Hi	Low	Low	Low	Low	304.52	1.20
SLIM 164	Low	Hi	Low	Low	Low	Nom	338.74	1.33
SLIM 165	Low	Hi	Low	Low	Low	Hi	338.74	1.33
SLIM 166	Low	Hi	Low	Low	Nom	Low	229.23	0.90
SLIM 167	Low	Hi	Low	Low	Nom	Nom	338.74	1.33
SLIM 168	Low	Hi	Low	Low	Nom	Hi	338.74	1.33
SLIM 169	Low	Hi	Low	Low	Hi	Low	278.61	1.09
SLIM 170	Low	Hi	Low	Low	Hi	Nom	304.52	1.20
SLIM 171	Low	Hi	Low	Low	Hi	Hi	310.16	1.22
SLIM 172	Low	Hi	Low	Nom	Low	Low	299.23	1.17
SLIM 173	Low	Hi	Low	Nom	Low	Nom	338.74	1.33
SLIM 174	Low	Hi	Low	Nom	Low	Hi	338.74	1.33
SLIM 175	Low	Hi	Low	Nom	Nom	Low	293.88	1.15
SLIM 176	Low	Hi	Low	Nom	Nom	Nom	338.74	1.33
SLIM 177	Low	Hi	Low	Nom	Nom	Hi	338.74	1.33
SLIM 178	Low	Hi	Low	Nom	Hi	Low	268.79	1.06
SLIM 179	Low	Hi	Low	Nom	Hi	Nom	293.88	1.15
SLIM 180	Low	Hi	Low	Nom	Hi	Hi	304.52	1.20
SLIM 181	Low	Hi	Low	Hi	Low	Low	273.83	1.07
SLIM 182	Low	Hi	Low	Hi	Low	Nom	299.23	1.17
SLIM 183	Low	Hi	Low	Hi	Low	Hi	304.52	1.20
SLIM 184	Low	Hi	Low	Hi	Nom	Low	263.87	1.04
SLIM 185	Low	Hi	Low	Hi	Nom	Nom	288.54	1.13
SLIM 186	Low	Hi	Low	Hi	Nom	Hi	304.52	1.20
SLIM 187	Low	Hi	Low	Hi	Hi	Low	250.25	0.98
SLIM 188	Low	Hi	Low	Hi	Hi	Nom	268.79	1.06
SLIM 189	Low	Hi	Low	Hi	Hi	Hi	283.77	1.11
SLIM 190	Low	Hi	Nom	Low	Low	Low	299.23	1.17
SLIM 191	Low	Hi	Nom	Low	Low	Nom	338.74	1.33
SLIM 192	Low	Hi	Nom	Low	Low	Hi	338.74	1.33
SLIM 193	Low	Hi	Nom	Low	Nom	Low	293.88	1.15
SLIM 194	Low	Hi	Nom	Low	Nom	Nom	338.74	1.33
SLIM 195	Low	Hi	Nom	Low	Nom	Hi	338.74	1.33
SLIM 196	Low	Hi	Nom	Low	Hi	Low	268.79	1.06
SLIM 197	Low	Hi	Nom	Low	Hi	Nom	293.88	1.15
SLIM 198	Low	Hi	Nom	Low	Hi	Hi	304.52	1.20
SLIM 199	Low	Hi	Nom	Nom	Low	Low	288.54	1.13
SLIM 200	Low	Hi	Nom	Nom	Low	Nom	338.74	1.33
SLIM 201	Low	Hi	Nom	Nom	Low	Hi	338.74	1.33
SLIM 202	Low	Hi	Nom	Nom	Nom	Low	278.61	1.09
SLIM 203	Low	Hi	Nom	Nom	Nom	Nom	338.74	1.33
SLIM 204	Low	Hi	Nom	Nom	Nom	Hi	338.74	1.33
SLIM 205	Low	Hi	Nom	Nom	Hi	Low	254.73	1.00

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 206	Low	Hi	Nom	Nom	Hi	Nom	283.77	1.11
SLIM 207	Low	Hi	Nom	Nom	Hi	Hi	304.52	1.20
SLIM 208	Low	Hi	Nom	Hi	Low	Low	263.87	1.04
SLIM 209	Low	Hi	Nom	Hi	Low	Nom	288.54	1.13
SLIM 210	Low	Hi	Nom	Hi	Low	Hi	304.52	1.20
SLIM 211	Low	Hi	Nom	Hi	Nom	Low	254.73	1.00
SLIM 212	Low	Hi	Nom	Hi	Nom	Nom	278.61	1.09
SLIM 213	Low	Hi	Nom	Hi	Nom	Hi	299.23	1.17
SLIM 214	Low	Hi	Nom	Hi	Hi	Low	241.3	0.95
SLIM 215	Low	Hi	Nom	Hi	Hi	Nom	254.73	1.00
SLIM 216	Low	Hi	Nom	Hi	Hi	Hi	273.83	1.07
SLIM 217	Low	Hi	Hi	Low	Low	Low	273.83	1.07
SLIM 218	Low	Hi	Hi	Low	Low	Nom	293.88	1.15
SLIM 219	Low	Hi	Hi	Low	Low	Hi	304.52	1.20
SLIM 220	Low	Hi	Hi	Low	Nom	Low	263.87	1.04
SLIM 221	Low	Hi	Hi	Low	Nom	Nom	288.54	1.13
SLIM 222	Low	Hi	Hi	Low	Nom	Hi	304.52	1.20
SLIM 223	Low	Hi	Hi	Low	Hi	Low	250.52	0.98
SLIM 224	Low	Hi	Hi	Low	Hi	Nom	268.79	1.06
SLIM 225	Low	Hi	Hi	Low	Hi	Hi	283.77	1.11
SLIM 226	Low	Hi	Hi	Nom	Low	Low	263.87	1.04
SLIM 227	Low	Hi	Hi	Nom	Low	Nom	288.54	1.13
SLIM 228	Low	Hi	Hi	Nom	Low	Hi	304.52	1.20
SLIM 229	Low	Hi	Hi	Nom	Nom	Low	254.73	1.00
SLIM 230	Low	Hi	Hi	Nom	Nom	Nom	278.61	1.09
SLIM 231	Low	Hi	Hi	Nom	Nom	Hi	299.23	1.17
SLIM 232	Low	Hi	Hi	Nom	Hi	Low	241.3	0.95
SLIM 233	Low	Hi	Hi	Nom	Hi	Nom	254.73	1.00
SLIM 234	Low	Hi	Hi	Nom	Hi	Hi	273.83	1.07
SLIM 235	Low	Hi	Hi	Hi	Low	Low	250.25	0.98
SLIM 236	Low	Hi	Hi	Hi	Low	Nom	263.87	1.04
SLIM 237	Low	Hi	Hi	Hi	Low	Hi	278.61	1.09
SLIM 238	Low	Hi	Hi	Hi	Nom	Low	237.09	0.93
SLIM 239	Low	Hi	Hi	Hi	Nom	Nom	254.73	1.00
SLIM 240	Low	Hi	Hi	Hi	Nom	Hi	273.83	1.07
SLIM 241	Low	Hi	Hi	Hi	Hi	Low	233.29	0.92
SLIM 242	Low	Hi	Hi	Hi	Hi	Nom	241.3	0.95
SLIM 243	Low	Hi	Hi	Hi	Hi	Hi	259.55	1.02
SLIM 244	Nom	Low	Low	Low	Low	Low	263.87	1.04
SLIM 245	Nom	Low	Low	Low	Low	Nom	288.54	1.13
SLIM 246	Nom	Low	Low	Low	Low	Hi	304.52	1.20
SLIM 247	Nom	Low	Low	Low	Nom	Low	250.25	0.98
SLIM 248	Nom	Low	Low	Low	Nom	Nom	278.61	1.09
SLIM 249	Nom	Low	Low	Low	Nom	Hi	299.23	1.17
SLIM 250	Nom	Low	Low	Low	Hi	Low	237.09	0.93
SLIM 251	Nom	Low	Low	Low	Hi	Nom	250.25	0.98
SLIM 252	Nom	Low	Low	Low	Hi	Hi	273.83	1.07
SLIM 253	Nom	Low	Low	Nom	Low	Low	245.72	0.96
SLIM 254	Nom	Low	Low	Nom	Low	Nom	273.83	1.07
SLIM 255	Nom	Low	Low	Nom	Low	Hi	299.23	1.17
SLIM 256	Nom	Low	Low	Nom	Nom	Low	229.08	0.90
SLIM 257	Nom	Low	Low	Nom	Nom	Nom	254.73	1.00
SLIM 258	Nom	Low	Low	Nom	Nom	Hi	293.88	1.15
SLIM 259	Nom	Low	Low	Nom	Hi	Low	216.94	0.85
SLIM 260	Nom	Low	Low	Nom	Hi	Nom	229.08	0.90
SLIM 261	Nom	Low	Low	Nom	Hi	Hi	263.87	1.04
SLIM 262	Nom	Low	Low	Hi	Low	Low	233.29	0.92
SLIM 263	Nom	Low	Low	Hi	Low	Nom	245.72	0.96
SLIM 264	Nom	Low	Low	Hi	Low	Hi	268.79	1.06
SLIM 265	Nom	Low	Low	Hi	Nom	Low	216.94	0.85
SLIM 266	Nom	Low	Low	Hi	Nom	Nom	225.34	0.88
SLIM 267	Nom	Low	Low	Hi	Nom	Hi	259.55	1.02
SLIM 268	Nom	Low	Low	Hi	Hi	Low	209.28	0.82
SLIM 269	Nom	Low	Low	Hi	Hi	Nom	216.94	0.85
SLIM 270	Nom	Low	Low	Hi	Hi	Hi	245.72	0.96
SLIM 271	Nom	Low	Nom	Low	Low	Low	245.72	0.96
SLIM 272	Nom	Low	Nom	Low	Low	Nom	273.83	1.07
SLIM 273	Nom	Low	Nom	Low	Low	Hi	299.23	1.17
SLIM 274	Nom	Low	Nom	Low	Nom	Low	229.08	0.90
SLIM 275	Nom	Low	Nom	Low	Nom	Nom	254.73	1.00

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 276	Nom	Low	Nom	Low	Nom	Hi	293.88	1.15
SLIM 277	Nom	Low	Nom	Low	Hi	Low	216.94	0.85
SLIM 278	Nom	Low	Nom	Low	Hi	Nom	229.08	0.90
SLIM 279	Nom	Low	Nom	Low	Hi	Hi	263.87	1.04
SLIM 280	Nom	Low	Nom	Nom	Low	Low	225.34	0.88
SLIM 281	Nom	Low	Nom	Nom	Low	Nom	245.72	0.96
SLIM 282	Nom	Low	Nom	Nom	Low	Hi	288.54	1.13
SLIM 283	Nom	Low	Nom	Nom	Nom	Low	191.69	0.75
SLIM 284	Nom	Low	Nom	Nom	Nom	Nom	191.69	0.75
SLIM 285	Nom	Low	Nom	Nom	Nom	Hi	278.61	1.09
SLIM 286	Nom	Low	Nom	Nom	Hi	Low	191.69	0.75
SLIM 287	Nom	Low	Nom	Nom	Hi	Nom	191.69	0.75
SLIM 288	Nom	Low	Nom	Nom	Hi	Hi	245.72	0.96
SLIM 289	Nom	Low	Nom	Hi	Low	Low	213.16	0.84
SLIM 290	Nom	Low	Nom	Hi	Low	Nom	221.01	0.87
SLIM 291	Nom	Low	Nom	Hi	Low	Hi	259.55	1.02
SLIM 292	Nom	Low	Nom	Hi	Nom	Low	191.69	0.75
SLIM 293	Nom	Low	Nom	Hi	Nom	Nom	191.69	0.75
SLIM 294	Nom	Low	Nom	Hi	Nom	Hi	245.72	0.96
SLIM 295	Nom	Low	Nom	Hi	Hi	Low	191.69	0.75
SLIM 296	Nom	Low	Nom	Hi	Hi	Nom	191.69	0.75
SLIM 297	Nom	Low	Nom	Hi	Hi	Hi	233.29	0.92
SLIM 298	Nom	Low	Hi	Low	Low	Low	233.29	0.92
SLIM 299	Nom	Low	Hi	Low	Low	Nom	145.72	0.57
SLIM 300	Nom	Low	Hi	Low	Low	Hi	268.79	1.06
SLIM 301	Nom	Low	Hi	Low	Nom	Low	216.94	0.85
SLIM 302	Nom	Low	Hi	Low	Nom	Nom	225.34	0.88
SLIM 303	Nom	Low	Hi	Low	Nom	Hi	259.55	1.02
SLIM 304	Nom	Low	Hi	Low	Hi	Low	209.28	0.82
SLIM 305	Nom	Low	Hi	Low	Hi	Nom	216.94	0.85
SLIM 306	Nom	Low	Hi	Low	Hi	Hi	245.72	0.96
SLIM 307	Nom	Low	Hi	Nom	Low	Low	213.16	0.84
SLIM 308	Nom	Low	Hi	Nom	Low	Nom	221.01	0.87
SLIM 309	Nom	Low	Hi	Nom	Low	Hi	259.55	1.02
SLIM 310	Nom	Low	Hi	Nom	Nom	Low	191.69	0.75
SLIM 311	Nom	Low	Hi	Nom	Nom	Nom	191.69	0.75
SLIM 312	Nom	Low	Hi	Nom	Nom	Hi	245.72	0.96
SLIM 313	Nom	Low	Hi	Nom	Hi	Low	191.69	0.75
SLIM 314	Nom	Low	Hi	Nom	Hi	Nom	191.69	0.75
SLIM 315	Nom	Low	Hi	Nom	Hi	Hi	233.29	0.92
SLIM 316	Nom	Low	Hi	Hi	Low	Low	205.69	0.81
SLIM 317	Nom	Low	Hi	Hi	Low	Nom	213.16	0.84
SLIM 318	Nom	Low	Hi	Hi	Low	Hi	241.3	0.95
SLIM 319	Nom	Low	Hi	Hi	Nom	Low	191.69	0.75
SLIM 320	Nom	Low	Hi	Hi	Nom	Nom	191.69	0.75
SLIM 321	Nom	Low	Hi	Hi	Nom	Hi	229.08	0.90
SLIM 322	Nom	Low	Hi	Hi	Hi	Low	191.69	0.75
SLIM 323	Nom	Low	Hi	Hi	Hi	Nom	191.69	0.75
SLIM 324	Nom	Low	Hi	Hi	Hi	Hi	221.01	0.87
SLIM 325	Nom	Nom	Low	Low	Low	Low	283.77	1.11
SLIM 326	Nom	Nom	Low	Low	Low	Nom	338.74	1.33
SLIM 327	Nom	Nom	Low	Low	Low	Hi	338.74	1.33
SLIM 328	Nom	Nom	Low	Low	Nom	Low	268.79	1.06
SLIM 329	Nom	Nom	Low	Low	Nom	Nom	338.74	1.33
SLIM 330	Nom	Nom	Low	Low	Nom	Hi	338.74	1.33
SLIM 331	Nom	Nom	Low	Low	Hi	Low	245.72	0.96
SLIM 332	Nom	Nom	Low	Low	Hi	Nom	273.83	1.07
SLIM 333	Nom	Nom	Low	Low	Hi	Hi	299.23	1.17
SLIM 334	Nom	Nom	Low	Nom	Low	Low	268.79	1.06
SLIM 335	Nom	Nom	Low	Nom	Low	Nom	338.74	1.33
SLIM 336	Nom	Nom	Low	Nom	Low	Hi	338.74	1.33
SLIM 337	Nom	Nom	Low	Nom	Nom	Low	245.72	0.96
SLIM 338	Nom	Nom	Low	Nom	Nom	Nom	338.74	1.33
SLIM 339	Nom	Nom	Low	Nom	Nom	Hi	338.74	1.33
SLIM 340	Nom	Nom	Low	Nom	Hi	Low	225.34	0.88
SLIM 341	Nom	Nom	Low	Nom	Hi	Nom	250.25	0.98
SLIM 342	Nom	Nom	Low	Nom	Hi	Hi	288.54	1.13
SLIM 343	Nom	Nom	Low	Hi	Low	Low	241.3	0.95
SLIM 344	Nom	Nom	Low	Hi	Low	Nom	263.87	1.04
SLIM 345	Nom	Nom	Low	Hi	Low	Hi	288.54	1.13

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 346	Nom	Nom	Low	Hi	Nom	Low	225.34	0.88
SLIM 347	Nom	Nom	Low	Hi	Nom	Nom	241.3	0.95
SLIM 348	Nom	Nom	Low	Hi	Nom	Hi	283.77	1.11
SLIM 349	Nom	Nom	Low	Hi	Hi	Low	213.16	0.84
SLIM 350	Nom	Nom	Low	Hi	Hi	Nom	225.34	0.88
SLIM 351	Nom	Nom	Low	Hi	Hi	Hi	259.55	1.02
SLIM 352	Nom	Nom	Nom	Low	Low	Low	268.79	1.06
SLIM 353	Nom	Nom	Nom	Low	Low	Nom	338.74	1.33
SLIM 354	Nom	Nom	Nom	Low	Low	Hi	338.74	1.33
SLIM 355	Nom	Nom	Nom	Low	Nom	Low	245.72	0.96
SLIM 356	Nom	Nom	Nom	Low	Nom	Nom	338.74	1.33
SLIM 357	Nom	Nom	Nom	Low	Nom	Hi	338.74	1.33
SLIM 358	Nom	Nom	Nom	Low	Hi	Low	225.34	0.88
SLIM 359	Nom	Nom	Nom	Low	Hi	Nom	250.25	0.98
SLIM 360	Nom	Nom	Nom	Low	Hi	Hi	288.54	1.13
SLIM 361	Nom	Nom	Nom	Nom	Low	Low	241.3	0.95
SLIM 362	Nom	Nom	Nom	Nom	Low	Nom	338.74	1.33
SLIM 363	Nom	Nom	Nom	Nom	Low	Hi	338.74	1.33
SLIM 364	Nom	Nom	Nom	Nom	Nom	Low	191.69	0.75
SLIM 365	Nom	Nom	Nom	Nom	Nom	Nom	254.73	1.00
SLIM 366	Nom	Nom	Nom	Nom	Nom	Hi	345.06	1.35
SLIM 367	Nom	Nom	Nom	Nom	Hi	Low	191.69	0.75
SLIM 368	Nom	Nom	Nom	Nom	Hi	Nom	188.08	0.74
SLIM 369	Nom	Nom	Nom	Nom	Hi	Hi	273.83	1.07
SLIM 370	Nom	Nom	Nom	Hi	Low	Low	221.01	0.87
SLIM 371	Nom	Nom	Nom	Hi	Low	Nom	237.09	0.93
SLIM 372	Nom	Nom	Nom	Hi	Low	Hi	278.61	1.09
SLIM 373	Nom	Nom	Nom	Hi	Nom	Low	191.69	0.75
SLIM 374	Nom	Nom	Nom	Hi	Nom	Nom	188.08	0.74
SLIM 375	Nom	Nom	Nom	Hi	Nom	Hi	263.87	1.04
SLIM 376	Nom	Nom	Nom	Hi	Hi	Low	191.69	0.75
SLIM 377	Nom	Nom	Nom	Hi	Hi	Nom	188.08	0.74
SLIM 378	Nom	Nom	Nom	Hi	Hi	Hi	241.3	0.95
SLIM 379	Nom	Nom	Hi	Low	Low	Low	241.3	0.95
SLIM 380	Nom	Nom	Hi	Low	Low	Nom	263.87	1.04
SLIM 381	Nom	Nom	Hi	Low	Low	Hi	288.54	1.13
SLIM 382	Nom	Nom	Hi	Low	Nom	Low	225.34	0.88
SLIM 383	Nom	Nom	Hi	Low	Nom	Nom	241.3	0.95
SLIM 384	Nom	Nom	Hi	Low	Nom	Hi	283.77	1.11
SLIM 385	Nom	Nom	Hi	Low	Hi	Low	213.16	0.84
SLIM 386	Nom	Nom	Hi	Low	Hi	Nom	225.34	0.88
SLIM 387	Nom	Nom	Hi	Low	Hi	Hi	259.55	1.02
SLIM 388	Nom	Nom	Hi	Nom	Low	Low	221.01	0.87
SLIM 389	Nom	Nom	Hi	Nom	Low	Nom	237.09	0.93
SLIM 390	Nom	Nom	Hi	Nom	Low	Hi	278.61	1.09
SLIM 391	Nom	Nom	Hi	Nom	Nom	Low	191.69	0.75
SLIM 392	Nom	Nom	Hi	Nom	Nom	Nom	188.08	0.74
SLIM 393	Nom	Nom	Hi	Nom	Nom	Hi	263.87	1.04
SLIM 394	Nom	Nom	Hi	Nom	Hi	Low	191.69	0.75
SLIM 395	Nom	Nom	Hi	Nom	Hi	Nom	188.08	0.74
SLIM 396	Nom	Nom	Hi	Nom	Hi	Hi	241.3	0.95
SLIM 397	Nom	Nom	Hi	Hi	Low	Low	209.28	0.82
SLIM 398	Nom	Nom	Hi	Hi	Low	Nom	216.94	0.85
SLIM 399	Nom	Nom	Hi	Hi	Low	Hi	254.73	1.00
SLIM 400	Nom	Nom	Hi	Hi	Nom	Low	191.69	0.75
SLIM 401	Nom	Nom	Hi	Hi	Nom	Nom	188.08	0.74
SLIM 402	Nom	Nom	Hi	Hi	Nom	Hi	241.3	0.95
SLIM 403	Nom	Nom	Hi	Hi	Hi	Low	191.69	0.75
SLIM 404	Nom	Nom	Hi	Hi	Hi	Nom	188.08	0.74
SLIM 405	Nom	Nom	Hi	Hi	Hi	Hi	229.08	0.90
SLIM 406	Nom	Hi	Low	Low	Low	Low	299.23	1.17
SLIM 407	Nom	Hi	Low	Low	Low	Nom	338.74	1.33
SLIM 408	Nom	Hi	Low	Low	Low	Hi	338.74	1.33
SLIM 409	Nom	Hi	Low	Low	Nom	Low	288.54	1.13
SLIM 410	Nom	Hi	Low	Low	Nom	Nom	338.74	1.33
SLIM 411	Nom	Hi	Low	Low	Nom	Hi	338.74	1.33
SLIM 412	Nom	Hi	Low	Low	Hi	Low	268.79	1.06
SLIM 413	Nom	Hi	Low	Low	Hi	Nom	293.88	1.15
SLIM 414	Nom	Hi	Low	Low	Hi	Hi	304.52	1.20
SLIM 415	Nom	Hi	Low	Nom	Low	Low	288.54	1.13

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 416	Nom	Hi	Low	Nom	Low	Nom	338.74	1.33
SLIM 417	Nom	Hi	Low	Nom	Low	Hi	338.74	1.33
SLIM 418	Nom	Hi	Low	Nom	Nom	Low	278.61	1.09
SLIM 419	Nom	Hi	Low	Nom	Nom	Nom	338.74	1.33
SLIM 420	Nom	Hi	Low	Nom	Nom	Hi	338.74	1.33
SLIM 421	Nom	Hi	Low	Nom	Hi	Low	254.73	1.00
SLIM 422	Nom	Hi	Low	Nom	Hi	Nom	283.77	1.11
SLIM 423	Nom	Hi	Low	Nom	Hi	Hi	299.23	1.17
SLIM 424	Nom	Hi	Low	Hi	Low	Low	263.87	1.04
SLIM 425	Nom	Hi	Low	Hi	Low	Nom	288.54	1.13
SLIM 426	Nom	Hi	Low	Hi	Low	Hi	299.23	1.17
SLIM 427	Nom	Hi	Low	Hi	Nom	Low	250.25	0.98
SLIM 428	Nom	Hi	Low	Hi	Nom	Nom	278.61	1.09
SLIM 429	Nom	Hi	Low	Hi	Nom	Hi	293.88	1.15
SLIM 430	Nom	Hi	Low	Hi	Hi	Low	237.09	0.93
SLIM 431	Nom	Hi	Low	Hi	Hi	Nom	254.73	1.00
SLIM 432	Nom	Hi	Low	Hi	Hi	Hi	273.83	1.07
SLIM 433	Nom	Hi	Nom	Low	Low	Low	288.54	1.13
SLIM 434	Nom	Hi	Nom	Low	Low	Nom	338.74	1.33
SLIM 435	Nom	Hi	Nom	Low	Low	Hi	338.74	1.33
SLIM 436	Nom	Hi	Nom	Low	Nom	Low	278.61	1.09
SLIM 437	Nom	Hi	Nom	Low	Nom	Nom	338.74	1.33
SLIM 438	Nom	Hi	Nom	Low	Nom	Hi	338.74	1.33
SLIM 439	Nom	Hi	Nom	Low	Hi	Low	254.73	1.00
SLIM 440	Nom	Hi	Nom	Low	Hi	Nom	283.77	1.11
SLIM 441	Nom	Hi	Nom	Low	Hi	Hi	299.23	1.17
SLIM 442	Nom	Hi	Nom	Nom	Low	Low	273.83	1.07
SLIM 443	Nom	Hi	Nom	Nom	Low	Nom	338.74	1.33
SLIM 444	Nom	Hi	Nom	Nom	Low	Hi	338.74	1.33
SLIM 445	Nom	Hi	Nom	Nom	Nom	Low	259.55	1.02
SLIM 446	Nom	Hi	Nom	Nom	Nom	Nom	345.06	1.35
SLIM 447	Nom	Hi	Nom	Nom	Nom	Hi	345.06	1.35
SLIM 448	Nom	Hi	Nom	Nom	Hi	Low	237.09	0.93
SLIM 449	Nom	Hi	Nom	Nom	Hi	Nom	263.87	1.04
SLIM 450	Nom	Hi	Nom	Nom	Hi	Hi	293.88	1.15
SLIM 451	Nom	Hi	Nom	Hi	Low	Low	250.25	0.98
SLIM 452	Nom	Hi	Nom	Hi	Low	Nom	273.83	1.07
SLIM 453	Nom	Hi	Nom	Hi	Low	Hi	293.88	1.15
SLIM 454	Nom	Hi	Nom	Hi	Nom	Low	233.29	0.92
SLIM 455	Nom	Hi	Nom	Hi	Nom	Nom	254.73	1.00
SLIM 456	Nom	Hi	Nom	Hi	Nom	Hi	288.54	1.13
SLIM 457	Nom	Hi	Nom	Hi	Hi	Low	225.34	0.88
SLIM 458	Nom	Hi	Nom	Hi	Hi	Nom	233.29	0.92
SLIM 459	Nom	Hi	Nom	Hi	Hi	Hi	263.87	1.04
SLIM 460	Nom	Hi	Hi	Low	Low	Low	263.87	1.04
SLIM 461	Nom	Hi	Hi	Low	Low	Nom	288.54	1.13
SLIM 462	Nom	Hi	Hi	Low	Low	Hi	299.23	1.17
SLIM 463	Nom	Hi	Hi	Low	Nom	Low	250.25	0.98
SLIM 464	Nom	Hi	Hi	Low	Nom	Nom	273.83	1.07
SLIM 465	Nom	Hi	Hi	Low	Nom	Hi	293.88	1.15
SLIM 466	Nom	Hi	Hi	Low	Hi	Low	237.09	0.93
SLIM 467	Nom	Hi	Hi	Low	Hi	Nom	254.73	1.00
SLIM 468	Nom	Hi	Hi	Low	Hi	Hi	273.83	1.07
SLIM 469	Nom	Hi	Hi	Nom	Low	Low	250.25	0.98
SLIM 470	Nom	Hi	Hi	Nom	Low	Nom	273.83	1.07
SLIM 471	Nom	Hi	Hi	Nom	Low	Hi	293.88	1.15
SLIM 472	Nom	Hi	Hi	Nom	Nom	Low	233.29	0.92
SLIM 473	Nom	Hi	Hi	Nom	Nom	Nom	254.73	1.00
SLIM 474	Nom	Hi	Hi	Nom	Nom	Hi	288.54	1.13
SLIM 475	Nom	Hi	Hi	Nom	Hi	Low	225.34	0.88
SLIM 476	Nom	Hi	Hi	Nom	Hi	Nom	233.29	0.92
SLIM 477	Nom	Hi	Hi	Nom	Hi	Hi	263.87	1.04
SLIM 478	Nom	Hi	Hi	Hi	Low	Low	233.29	0.92
SLIM 479	Nom	Hi	Hi	Hi	Low	Nom	245.72	0.96
SLIM 480	Nom	Hi	Hi	Hi	Low	Hi	268.79	1.06
SLIM 481	Nom	Hi	Hi	Hi	Nom	Low	221.01	0.87
SLIM 482	Nom	Hi	Hi	Hi	Nom	Nom	233.29	0.92
SLIM 483	Nom	Hi	Hi	Hi	Nom	Hi	259.55	1.02
SLIM 484	Nom	Hi	Hi	Hi	Hi	Low	216.94	0.85
SLIM 485	Nom	Hi	Hi	Hi	Hi	Nom	221.01	0.87

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 486	Nom	Hi	Hi	Hi	Hi	Hi	245.72	0.96
SLIM 487	Hi	Low	Low	Low	Low	Low	241.3	0.95
SLIM 488	Hi	Low	Low	Low	Low	Nom	254.73	1.00
SLIM 489	Hi	Low	Low	Low	Low	Hi	273.83	1.07
SLIM 490	Hi	Low	Low	Low	Nom	Low	233.29	0.92
SLIM 491	Hi	Low	Low	Low	Nom	Nom	245.72	0.96
SLIM 492	Hi	Low	Low	Low	Nom	Hi	268.79	1.06
SLIM 493	Hi	Low	Low	Low	Hi	Low	255.34	1.00
SLIM 494	Hi	Low	Low	Low	Hi	Nom	233.29	0.92
SLIM 495	Hi	Low	Low	Low	Hi	Hi	254.73	1.00
SLIM 496	Hi	Low	Low	Nom	Low	Low	229.08	0.90
SLIM 497	Hi	Low	Low	Nom	Low	Nom	241.3	0.95
SLIM 498	Hi	Low	Low	Nom	Low	Hi	268.79	1.06
SLIM 499	Hi	Low	Low	Nom	Nom	Low	213.16	0.84
SLIM 500	Hi	Low	Low	Nom	Nom	Nom	225.34	0.88
SLIM 501	Hi	Low	Low	Nom	Nom	Hi	254.73	1.00
SLIM 502	Hi	Low	Low	Nom	Hi	Low	209.25	0.82
SLIM 503	Hi	Low	Low	Nom	Hi	Nom	213.16	0.84
SLIM 504	Hi	Low	Low	Nom	Hi	Hi	241.3	0.95
SLIM 505	Hi	Low	Low	Hi	Low	Low	221.01	0.87
SLIM 506	Hi	Low	Low	Hi	Low	Nom	229.08	0.90
SLIM 507	Hi	Low	Low	Hi	Low	Hi	250.25	0.98
SLIM 508	Hi	Low	Low	Hi	Nom	Low	209.28	0.82
SLIM 509	Hi	Low	Low	Hi	Nom	Nom	213.16	0.84
SLIM 510	Hi	Low	Low	Hi	Nom	Hi	241.3	0.95
SLIM 511	Hi	Low	Low	Hi	Hi	Low	205.69	0.81
SLIM 512	Hi	Low	Low	Hi	Hi	Nom	209.28	0.82
SLIM 513	Hi	Low	Low	Hi	Hi	Hi	233.29	0.92
SLIM 514	Hi	Low	Nom	Low	Low	Low	229.08	0.90
SLIM 515	Hi	Low	Nom	Low	Low	Nom	241.3	0.95
SLIM 516	Hi	Low	Nom	Low	Low	Hi	263.87	1.04
SLIM 517	Hi	Low	Nom	Low	Nom	Low	213.16	0.84
SLIM 518	Hi	Low	Nom	Low	Nom	Nom	225.34	0.88
SLIM 519	Hi	Low	Nom	Low	Nom	Hi	254.73	1.00
SLIM 520	Hi	Low	Nom	Low	Hi	Low	209.28	0.82
SLIM 521	Hi	Low	Nom	Low	Hi	Nom	213.16	0.84
SLIM 522	Hi	Low	Nom	Low	Hi	Hi	241.3	0.95
SLIM 523	Hi	Low	Nom	Nom	Low	Low	213.16	0.84
SLIM 524	Hi	Low	Nom	Nom	Low	Nom	221.01	0.87
SLIM 525	Hi	Low	Nom	Nom	Low	Hi	254.73	1.00
SLIM 526	Hi	Low	Nom	Nom	Nom	Low	191.69	0.75
SLIM 527	Hi	Low	Nom	Nom	Nom	Nom	191.69	0.75
SLIM 528	Hi	Low	Nom	Nom	Nom	Hi	241.3	0.95
SLIM 529	Hi	Low	Nom	Nom	Hi	Low	191.69	0.75
SLIM 530	Hi	Low	Nom	Nom	Hi	Nom	191.69	0.75
SLIM 531	Hi	Low	Nom	Nom	Hi	Hi	229.08	0.90
SLIM 532	Hi	Low	Nom	Hi	Low	Low	205.69	0.81
SLIM 533	Hi	Low	Nom	Hi	Low	Nom	209.28	0.82
SLIM 534	Hi	Low	Nom	Hi	Low	Hi	241.3	0.95
SLIM 535	Hi	Low	Nom	Hi	Nom	Low	191.69	0.75
SLIM 536	Hi	Low	Nom	Hi	Nom	Nom	191.69	0.75
SLIM 537	Hi	Low	Nom	Hi	Nom	Hi	229.08	0.90
SLIM 538	Hi	Low	Nom	Hi	Hi	Low	191.69	0.75
SLIM 539	Hi	Low	Nom	Hi	Hi	Nom	191.69	0.75
SLIM 540	Hi	Low	Nom	Hi	Hi	Hi	221.01	0.87
SLIM 541	Hi	Low	Hi	Low	Low	Low	221.01	0.87
SLIM 542	Hi	Low	Hi	Low	Low	Nom	229.08	0.90
SLIM 543	Hi	Low	Hi	Low	Low	Hi	250.25	0.98
SLIM 544	Hi	Low	Hi	Low	Nom	Low	209.28	0.82
SLIM 545	Hi	Low	Hi	Low	Nom	Nom	213.16	0.84
SLIM 546	Hi	Low	Hi	Low	Nom	Hi	241.3	0.95
SLIM 547	Hi	Low	Hi	Low	Hi	Low	205.69	0.81
SLIM 548	Hi	Low	Hi	Low	Hi	Nom	209.28	0.82
SLIM 549	Hi	Low	Hi	Low	Hi	Hi	233.29	0.92
SLIM 550	Hi	Low	Hi	Nom	Low	Low	205.69	0.81
SLIM 551	Hi	Low	Hi	Nom	Low	Nom	209.28	0.82
SLIM 552	Hi	Low	Hi	Nom	Low	Hi	241.3	0.95
SLIM 553	Hi	Low	Hi	Nom	Nom	Low	191.69	0.75
SLIM 554	Hi	Low	Hi	Nom	Nom	Nom	191.69	0.75
SLIM 555	Hi	Low	Hi	Nom	Nom	Hi	229.08	0.90

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 556	Hi	Low	Hi	Nom	Hi	Low	191.69	0.75
SLIM 557	Hi	Low	Hi	Nom	Hi	Nom	191.69	0.75
SLIM 558	Hi	Low	Hi	Nom	Hi	Hi	221.01	0.87
SLIM 559	Hi	Low	Hi	Hi	Low	Low	202.37	0.79
SLIM 560	Hi	Low	Hi	Hi	Low	Nom	205.69	0.81
SLIM 561	Hi	Low	Hi	Hi	Low	Hi	229.08	0.90
SLIM 562	Hi	Low	Hi	Hi	Nom	Low	191.69	0.75
SLIM 563	Hi	Low	Hi	Hi	Nom	Nom	191.69	0.75
SLIM 564	Hi	Low	Hi	Hi	Nom	Hi	221.01	0.87
SLIM 565	Hi	Low	Hi	Hi	Hi	Low	191.69	0.75
SLIM 566	Hi	Low	Hi	Hi	Hi	Nom	191.69	0.75
SLIM 567	Hi	Low	Hi	Hi	Hi	Hi	216.94	0.85
SLIM 568	Hi	Nom	Low	Low	Low	Low	254.73	1.00
SLIM 569	Hi	Nom	Low	Low	Low	Nom	273.83	1.07
SLIM 570	Hi	Nom	Low	Low	Low	Hi	293.88	1.15
SLIM 571	Hi	Nom	Low	Low	Nom	Low	241.3	0.95
SLIM 572	Hi	Nom	Low	Low	Nom	Nom	259.55	1.02
SLIM 573	Hi	Nom	Low	Low	Nom	Hi	283.77	1.11
SLIM 574	Hi	Nom	Low	Low	Hi	Low	229.08	0.90
SLIM 575	Hi	Nom	Low	Low	Hi	Nom	241.3	0.95
SLIM 576	Hi	Nom	Low	Low	Hi	Hi	263.87	1.04
SLIM 577	Hi	Nom	Low	Nom	Low	Low	237.09	0.93
SLIM 578	Hi	Nom	Low	Nom	Low	Nom	259.55	1.02
SLIM 579	Hi	Nom	Low	Nom	Low	Hi	283.77	1.11
SLIM 580	Hi	Nom	Low	Nom	Nom	Low	221.01	0.87
SLIM 581	Hi	Nom	Low	Nom	Nom	Nom	237.09	0.93
SLIM 582	Hi	Nom	Low	Nom	Nom	Hi	273.83	1.07
SLIM 583	Hi	Nom	Low	Nom	Hi	Low	213.16	0.84
SLIM 584	Hi	Nom	Low	Nom	Hi	Nom	221.01	0.87
SLIM 585	Hi	Nom	Low	Nom	Hi	Hi	254.73	1.00
SLIM 586	Hi	Nom	Low	Hi	Low	Low	225.34	0.88
SLIM 587	Hi	Nom	Low	Hi	Low	Nom	237.09	0.93
SLIM 588	Hi	Nom	Low	Hi	Low	Hi	263.87	1.04
SLIM 589	Hi	Nom	Low	Hi	Nom	Low	213.16	0.84
SLIM 590	Hi	Nom	Low	Hi	Nom	Nom	221.01	0.87
SLIM 591	Hi	Nom	Low	Hi	Nom	Hi	250.25	0.98
SLIM 592	Hi	Nom	Low	Hi	Hi	Low	209.28	0.82
SLIM 593	Hi	Nom	Low	Hi	Hi	Nom	213.16	0.84
SLIM 594	Hi	Nom	Low	Hi	Hi	Hi	241.3	0.95
SLIM 595	Hi	Nom	Nom	Low	Low	Low	237.09	0.93
SLIM 596	Hi	Nom	Nom	Low	Low	Nom	259.55	1.02
SLIM 597	Hi	Nom	Nom	Low	Low	Hi	283.77	1.11
SLIM 598	Hi	Nom	Nom	Low	Nom	Low	221.01	0.87
SLIM 599	Hi	Nom	Nom	Low	Nom	Nom	237.09	0.93
SLIM 600	Hi	Nom	Nom	Low	Nom	Hi	273.83	1.07
SLIM 601	Hi	Nom	Nom	Low	Hi	Low	213.16	0.84
SLIM 602	Hi	Nom	Nom	Low	Hi	Nom	221.01	0.87
SLIM 603	Hi	Nom	Nom	Low	Hi	Hi	254.73	1.00
SLIM 604	Hi	Nom	Nom	Nom	Low	Low	216.94	0.85
SLIM 605	Hi	Nom	Nom	Nom	Low	Nom	233.29	0.92
SLIM 606	Hi	Nom	Nom	Nom	Low	Hi	273.83	1.07
SLIM 607	Hi	Nom	Nom	Nom	Nom	Low	191.69	0.75
SLIM 608	Hi	Nom	Nom	Nom	Nom	Nom	188.08	0.74
SLIM 609	Hi	Nom	Nom	Nom	Nom	Hi	259.55	1.02
SLIM 610	Hi	Nom	Nom	Nom	Hi	Low	191.69	0.75
SLIM 611	Hi	Nom	Nom	Nom	Hi	Nom	188.08	0.74
SLIM 612	Hi	Nom	Nom	Nom	Hi	Hi	237.09	0.93
SLIM 613	Hi	Nom	Nom	Hi	Low	Low	209.28	0.82
SLIM 614	Hi	Nom	Nom	Hi	Low	Nom	216.94	0.85
SLIM 615	Hi	Nom	Nom	Hi	Low	Hi	250.25	0.98
SLIM 616	Hi	Nom	Nom	Hi	Nom	Low	191.69	0.75
SLIM 617	Hi	Nom	Nom	Hi	Nom	Nom	188.08	0.74
SLIM 618	Hi	Nom	Nom	Hi	Nom	Hi	237.09	0.93
SLIM 619	Hi	Nom	Nom	Hi	Hi	Low	191.69	0.75
SLIM 620	Hi	Nom	Nom	Hi	Hi	Nom	188.08	0.74
SLIM 621	Hi	Nom	Nom	Hi	Hi	Hi	225.34	0.88
SLIM 622	Hi	Nom	Hi	Low	Low	Low	225.34	0.88
SLIM 623	Hi	Nom	Hi	Low	Low	Nom	237.09	0.93
SLIM 624	Hi	Nom	Hi	Low	Low	Hi	259.55	1.02
SLIM 625	Hi	Nom	Hi	Low	Nom	Low	213.16	0.84

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 626	Hi	Nom	Hi	Low	Nom	Nom	221.01	0.87
SLIM 627	Hi	Nom	Hi	Low	Nom	Hi	250.25	0.98
SLIM 628	Hi	Nom	Hi	Low	Hi	Low	209.28	0.82
SLIM 629	Hi	Nom	Hi	Low	Hi	Nom	213.16	0.84
SLIM 630	Hi	Nom	Hi	Low	Hi	Hi	241.3	0.95
SLIM 631	Hi	Nom	Hi	Nom	Low	Low	209.28	0.82
SLIM 632	Hi	Nom	Hi	Nom	Low	Nom	216.94	0.85
SLIM 633	Hi	Nom	Hi	Nom	Low	Hi	250.25	0.98
SLIM 634	Hi	Nom	Hi	Nom	Nom	Low	191.69	0.75
SLIM 635	Hi	Nom	Hi	Nom	Nom	Nom	188.08	0.74
SLIM 636	Hi	Nom	Hi	Nom	Nom	Hi	237.09	0.93
SLIM 637	Hi	Nom	Hi	Nom	Hi	Low	191.69	0.75
SLIM 638	Hi	Nom	Hi	Nom	Hi	Nom	188.08	0.74
SLIM 639	Hi	Nom	Hi	Nom	Hi	Hi	225.34	0.88
SLIM 640	Hi	Nom	Hi	Hi	Low	Low	205.69	0.81
SLIM 641	Hi	Nom	Hi	Hi	Low	Nom	209.28	0.82
SLIM 642	Hi	Nom	Hi	Hi	Low	Hi	237.09	0.93
SLIM 643	Hi	Nom	Hi	Hi	Nom	Low	191.69	0.75
SLIM 644	Hi	Nom	Hi	Hi	Nom	Nom	188.08	0.74
SLIM 645	Hi	Nom	Hi	Hi	Nom	Hi	225.34	0.88
SLIM 646	Hi	Nom	Hi	Hi	Hi	Low	191.69	0.75
SLIM 647	Hi	Nom	Hi	Hi	Hi	Nom	188.08	0.74
SLIM 648	Hi	Nom	Hi	Hi	Hi	Hi	221.01	0.87
SLIM 649	Hi	Hi	Low	Low	Low	Low	268.79	1.06
SLIM 650	Hi	Hi	Low	Low	Low	Nom	288.54	1.13
SLIM 651	Hi	Hi	Low	Low	Low	Hi	299.23	1.17
SLIM 652	Hi	Hi	Low	Low	Nom	Low	259.55	1.02
SLIM 653	Hi	Hi	Low	Low	Nom	Nom	283.77	1.11
SLIM 654	Hi	Hi	Low	Low	Nom	Hi	293.88	1.15
SLIM 655	Hi	Hi	Low	Low	Hi	Low	245.72	0.96
SLIM 656	Hi	Hi	Low	Low	Hi	Nom	263.87	1.04
SLIM 657	Hi	Hi	Low	Low	Hi	Hi	278.61	1.09
SLIM 658	Hi	Hi	Low	Nom	Low	Low	259.55	1.02
SLIM 659	Hi	Hi	Low	Nom	Low	Nom	278.61	1.09
SLIM 660	Hi	Hi	Low	Nom	Low	Hi	293.88	1.15
SLIM 661	Hi	Hi	Low	Nom	Nom	Low	245.72	0.96
SLIM 662	Hi	Hi	Low	Nom	Nom	Nom	268.79	1.06
SLIM 663	Hi	Hi	Low	Nom	Nom	Hi	288.54	1.13
SLIM 664	Hi	Hi	Low	Nom	Hi	Low	237.09	0.93
SLIM 665	Hi	Hi	Low	Nom	Hi	Nom	250.25	0.98
SLIM 666	Hi	Hi	Low	Nom	Hi	Hi	268.79	1.06
SLIM 667	Hi	Hi	Low	Hi	Low	Low	245.72	0.96
SLIM 668	Hi	Hi	Low	Hi	Low	Nom	259.55	1.02
SLIM 669	Hi	Hi	Low	Hi	Low	Hi	273.83	1.07
SLIM 670	Hi	Hi	Low	Hi	Nom	Low	233.29	0.92
SLIM 671	Hi	Hi	Low	Hi	Nom	Nom	245.72	0.96
SLIM 672	Hi	Hi	Low	Hi	Nom	Hi	268.79	1.06
SLIM 673	Hi	Hi	Low	Hi	Hi	Low	229.08	0.90
SLIM 674	Hi	Hi	Low	Hi	Hi	Nom	237.09	0.93
SLIM 675	Hi	Hi	Low	Hi	Hi	Hi	254.73	1.00
SLIM 676	Hi	Hi	Nom	Low	Low	Low	259.55	1.02
SLIM 677	Hi	Hi	Nom	Low	Low	Nom	278.61	1.09
SLIM 678	Hi	Hi	Nom	Low	Low	Hi	293.88	1.15
SLIM 679	Hi	Hi	Nom	Low	Nom	Low	245.72	0.96
SLIM 680	Hi	Hi	Nom	Low	Nom	Nom	268.79	1.06
SLIM 681	Hi	Hi	Nom	Low	Nom	Hi	288.54	1.13
SLIM 682	Hi	Hi	Nom	Low	Hi	Low	237.09	0.93
SLIM 683	Hi	Hi	Nom	Low	Hi	Nom	250.25	0.98
SLIM 684	Hi	Hi	Nom	Low	Hi	Hi	268.79	1.06
SLIM 685	Hi	Hi	Nom	Nom	Low	Low	245.72	0.96
SLIM 686	Hi	Hi	Nom	Nom	Low	Nom	268.79	1.06
SLIM 687	Hi	Hi	Nom	Nom	Low	Hi	288.54	1.13
SLIM 688	Hi	Hi	Nom	Nom	Nom	Low	229.08	0.90
SLIM 689	Hi	Hi	Nom	Nom	Nom	Nom	250.25	0.98
SLIM 690	Hi	Hi	Nom	Nom	Nom	Hi	278.61	1.09
SLIM 691	Hi	Hi	Nom	Nom	Hi	Low	221.01	0.87
SLIM 692	Hi	Hi	Nom	Nom	Hi	Nom	233.29	0.92
SLIM 693	Hi	Hi	Nom	Nom	Hi	Hi	259.55	1.02
SLIM 694	Hi	Hi	Nom	Hi	Low	Low	233.29	0.92
SLIM 695	Hi	Hi	Nom	Hi	Low	Nom	245.72	0.96

Run	Q1	Q3	Q4	Q5	Q6	Q9	Effort Months	Change from Nominal
SLIM 696	Hi	Hi	Nom	Hi	Low	Hi	263.87	1.04
SLIM 697	Hi	Hi	Nom	Hi	Nom	Low	221.01	0.87
SLIM 698	Hi	Hi	Nom	Hi	Nom	Nom	229.08	0.90
SLIM 699	Hi	Hi	Nom	Hi	Nom	Hi	259.55	1.02
SLIM 700	Hi	Hi	Nom	Hi	Hi	Low	213.16	0.84
SLIM 701	Hi	Hi	Nom	Hi	Hi	Nom	221.01	0.87
SLIM 702	Hi	Hi	Nom	Hi	Hi	Hi	245.72	0.96
SLIM 703	Hi	Hi	Hi	Low	Low	Low	245.72	0.96
SLIM 704	Hi	Hi	Hi	Low	Low	Nom	259.55	1.02
SLIM 705	Hi	Hi	Hi	Low	Low	Hi	273.83	1.07
SLIM 706	Hi	Hi	Hi	Low	Nom	Low	233.83	0.92
SLIM 707	Hi	Hi	Hi	Low	Nom	Nom	245.72	0.96
SLIM 708	Hi	Hi	Hi	Low	Nom	Hi	268.72	1.05
SLIM 709	Hi	Hi	Hi	Low	Hi	Low	229.08	0.90
SLIM 710	Hi	Hi	Hi	Low	Hi	Nom	237.09	0.93
SLIM 711	Hi	Hi	Hi	Low	Hi	Hi	254.73	1.00
SLIM 712	Hi	Hi	Hi	Nom	Low	Low	233.29	0.92
SLIM 713	Hi	Hi	Hi	Nom	Low	Nom	245.72	0.96
SLIM 714	Hi	Hi	Hi	Nom	Low	Hi	263.87	1.04
SLIM 715	Hi	Hi	Hi	Nom	Nom	Low	221.01	0.87
SLIM 716	Hi	Hi	Hi	Nom	Nom	Nom	229.08	0.90
SLIM 717	Hi	Hi	Hi	Nom	Nom	Hi	259.55	1.02
SLIM 718	Hi	Hi	Hi	Nom	Hi	Low	213.16	0.84
SLIM 719	Hi	Hi	Hi	Nom	Hi	Nom	221.01	0.87
SLIM 720	Hi	Hi	Hi	Nom	Hi	Hi	245.72	0.96
SLIM 721	Hi	Hi	Hi	Hi	Low	Low	225.34	0.88
SLIM 722	Hi	Hi	Hi	Hi	Low	Nom	233.29	0.92
SLIM 723	Hi	Hi	Hi	Hi	Low	Hi	250.25	0.98
SLIM 724	Hi	Hi	Hi	Hi	Nom	Low	213.16	0.84
SLIM 725	Hi	Hi	Hi	Hi	Nom	Nom	221.01	0.87
SLIM 726	Hi	Hi	Hi	Hi	Nom	Hi	245.72	0.96
SLIM 727	Hi	Hi	Hi	Hi	Hi	Low	209.28	0.82
SLIM 728	Hi	Hi	Hi	Hi	Hi	Nom	213.16	0.84
SLIM 729	Hi	Hi	Hi	Hi	Hi	Hi	237.09	0.93

Appendix 10 PRICE S Data Table

Run	PROFAC	CPLX1	CPLXM	Effort Estimate	Change From Nominal
PRICE S 1	5.5	0.01	1	111.61	0.06
PRICE S 2	5.5	0.01	2	783.55	0.46
PRICE S 3	5.5	0.01	3	1303.03	0.76
PRICE S 4	5.5	1	1	1567.99	0.91
PRICE S 5	5.5	1	2	2307.77	1.34
PRICE S 6	5.5	1	3	2938.59	1.71
PRICE S 7	5.5	3	1	5017.39	2.92
PRICE S 8	5.5	3	2	0.00	0.00
PRICE S 9	5.5	3	3	0.00	0.00
PRICE S 10	5	0.01	1	124.17	0.07
PRICE S 11	5	0.01	2	860.88	0.50
PRICE S 12	5	0.01	3	1428.69	0.83
PRICE S 13	5	1	1	1717.20	1.00
PRICE S 14	5	1	2	2524.12	1.47
PRICE S 15	5	1	3	3211.64	1.87
PRICE S 16	5	3	1	5471.76	3.19
PRICE S 17	5	3	2	0.00	0.00
PRICE S 18	5	3	3	0.00	0.00
PRICE S 19	4.5	0.01	1	139.64	0.08
PRICE S 20	4.5	0.01	2	954.23	0.56
PRICE S 21	4.5	0.01	3	1579.84	0.92
PRICE S 22	4.5	1	1	1896.25	1.10
PRICE S 23	4.5	1	2	2783.08	1.62
PRICE S 24	4.5	1	3	3537.96	2.06
PRICE S 25	4.5	3	1	6012.29	3.50
PRICE S 26	4.5	3	2	0.00	0.00
PRICE S 27	4.5	3	3	0.00	0.00

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14. ABSTRACT
Software capabilities have steadily increased over the last half century. The Department of Defense has seized this increased capability and used it to advance the warfighter's weapon systems. However, this dependence on software capabilities has come with enormous cost. The risks of software development must be understood to develop an accurate cost estimate.

Department of Defense cost estimators traditionally depend on parametric models to develop an estimate for a software development project. Many commercial parametric software cost estimating models exist such as COCOMO II, SEER-SEM, SLIM, and PRICE S.

Research was performed to determine the quantitative impact of personnel parameters on the effort estimate in the closed architecture models. Using a design of experiments structure, personnel parameters were varied through three levels for each model. The data was then analyzed to determine the impact of each parameter at each level by evaluating the change from a baseline estimate. The parameters were evaluated to determine characteristics including linearity, independence between input parameters, impact range and effort multipliers. The results will enable DoD cost estimators to understand potential estimation errors resulting from inaccurately assessing each input factor. Risk ranges can be built around the final estimate based on the research results.

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